TENNESSEE VALLEY AUTHORITY

DRAFT

ENVIRONMENTAL STATEMENT

HARTSVILLE NUCLEAR PLANTS

SUMMARY SHEET
ENVIRONMENTAL STATEMENT
HARTSVILLE NUCLEAR PLANT

[X] Draft [ ] Final environmental statement prepared by the Tennessee Valley Authority

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1. [X] Administrative action [ ] Legislative action

2. This action is the construction and operation of a 4-unit nuclear plant in Smith and Trousdale Counties, Tennessee.

3. Construction and operation of the plant is expected to have no significant adverse impact on land use and water use. No significant adverse impact is expected on water quality, fish, or aquatic life resulting from discharges of heated water and treated radioactive, chemical, and sanitary wastes into the Cumberland River. The small quantities of radioactive materials that are released will result in doses within the limits of the Atomic Energy Commission's proposed Appendix I to 10 CFR Part 50. There should be no detectable impact due to these releases. A long-term favorable impact on the economy of the area is expected. Operation of the closed-cycle cooling towers will result in evaporation of water and release of heat into the air. There will be a slight increase in temperature of water returned to the Cumberland River. The small quantities of fish larvae and plankton drawn into the closed cooling system will be destroyed. Construction of the plant will result in some reservoir turbidity. A small amount of land will be converted from agricultural to industrial use. Buildup of construction employees may initially strain the public and private sectors to provide housing, schools, and other services.

4. Baseloaded coal-fired and nuclear-fueled units were considered to meet the 1980-1981 winter peak load. Nuclear units were selected due to the significant environmental advantages and lower costs. Due to similar power supply situations faced by other utilities, the purchase of power in the quantities needed was not a realistic alternative.

5. Alternative systems were considered for heat dissipation, cooling tower blowdown treatment, makeup water treatment plant sludge treatment, makeup demineralizer spent regenerant treatment, biocide treatment, sanitary waste treatment, reduction in radioactive products discharged from the plant, water intake, plant liquid discharge

system and transmission facilities. Selection of these proposed systems were made on the basis of a balancing of economic costs and reductions in environmental impacts using the cost/benefit approach as set out in the U.S. Atomic Energy Commission's Regulatory Guide 4.2.

6. Federal agencies to review are:

Advisory Council on Historical Preservation
Appalachian Regional Commission
Atomic Energy Commission
Council on Environmental Quality
Environmental Protection Agency
Federal Power Commission
Department of Agriculture
Federal Energy Administration
Department of Commerce
Department of the Army
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation

State and local agencies to review are:

Office of Urban and Federal Affairs, State of Tennessee
Mid-Cumberland Council of Governments
Upper Cumberland Development District

7. The draft statement was sent to the Council on Environmental Quality and made available to the public on November 25, 1974.

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CHAPTER 12 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

INTRODUCTION

TVA is a corporate agency of the United States created by the Tennessee Valley Authority Act of 1933 (48 Stat. 58, as amended, 16 U.S.C. §§ 831-831dd [1970]). In addition to its programs of flood control, navigation, and regional development, TVA operates a power system supplying the power requirements for an area of approximately 80,000 square miles containing about 6.5 million people. Except for direct service by TVA to certain industrial customers and Federal installations with large or unusual power requirements, TVA power is supplied to the ultimate consumer by 160 municipalities and rural electric cooperatives which purchase their power requirements from TVA. TVA is interconnected at 26 points with neighboring utility systems.

The TVA generating system consists of 29 hydro generating plants and 12 fossil-fueled steam generating plants now in operation. In addition, power from Corps of Engineers' dams in the Cumberland River basin and dams owned by the Aluminum Company of America on Tennessee River tributaries is made available to TVA under long-term contracts.

In the period 1964-1973, peak demands increased 55 percent and energy consumption increased 60 percent. These demands are expected to continue to increase in the future. In order to keep pace with the growing demand, it has been necessary to add substantial capacity to the generating and transmission system on a regular basis. The present system capacity is discussed in Section 1.1 of this document.

The Hartsville project actually consists of two identical 2-unit plants and is sometimes referred to in this draft statement as the Hartsville Nuclear Plants. This project is proposed to satisfy, in part, TVA's obligation to supply an ample amount of electricity to the area which TVA serves. The decision to locate the plant at Hartsville was made after an extensive study of various alternate sites and the relative costs, both environmental and monetary, which would be expected to result from locating a nuclear plant at them.

An environmental report was filed July 1, 1974, pursuant to AEC regulations in support of TVA's application to construct and operate the plant. This report contains the detailed environmental data and analyses which were used in the environmental evaluation. A preliminary safety analysis report was also filed in support of the application. The final safety analysis report will be submitted to AEC at a later date, along with a request for authorization to operate the four units at the designed power level. Under the current schedule, TVA expects to begin to load the nuclear fuel for the first unit in June 1980. Full power operation of the four units is expected in December 1980, June 1981, December 1981, and June 1982, respectively.

As a Federal agency, TVA is subject to the requirements of the National Environmental Policy Act of 1969 (NEPA) which became effective on January 1, 1970. In carrying out its responsibilities under the TVA

Act, TVA follows a policy designed to develop and enhance a quality environment. As a result of this policy, TVA has long considered environmental matters in its decisionmaking. Offices and divisions within TVA employ personnel with a wide diversity of experience and academic training which enables TVA to utilize a systematic, interdisciplinary approach to ensure the integrated use of the natural and social sciences and the environmental design arts in planning and decisionmaking as required by NEPA. This statement on the environmental considerations relating to the Hartsville Nuclear Plants covers the environmental considerations set out in Section 102(2)(C) of NEPA, as implemented by the Council on Environmental Quality (CEQ) and AEC guidelines. It is being sent to state and Federal agencies for review and comment pursuant to that Act as implemented by guidelines issued by the CEQ and Office of Management and Budget Circular A-95.

It should be noted that, although the four units will begin operation at different times, for impact assessment this environmental statement considers all units as operating in order to adequately assess the impact of the project on the environment, and so that consideration of the cumulative effects of the project can be assured.

The TVA power system is constantly changing and numerous studies and programs which provide fresh data and new insights are conducted continually by TVA. The information contained in this draft environmental statement is current through July 31, 1974.

In preparing this draft statement, TVA has been particularly conscious of CEQ's guidance to avoid highly technical and specialized analyses and data in the body of the statement. Accordingly, such information has been included in the environmental report filed with the AEC. The environmental report is available in the AEC public document room, 1717 H Street, Washington, D.C.; the TVA Information Office, New Sprankle Building, Knoxville, Tennessee; and the Fred A. Vaught Library, 311 Whiteoak Street, Hartsville, Tennessee.

1.1 Need for Power

The TVA was established to develop the Tennessee River system and to assist in the development of other resources of the Tennessee Valley and adjoining areas. Part of this resource development program is the generation, transmission, and sale of electric power. TVA supplies the electric power needs of an area of 80,000 square miles covering practically all of Tennessee, portions of southwestern Kentucky, northeastern Mississippi, northern Alabama and Georgia, and small sections of North Carolina and Virginia. This supplied area has a total population of about 6.5 million people. TVA provides electric power to three major groups of customers: (1) municipal electric systems and rural electric cooperatives, (2) directly served industries, and (3) directly served Federal agencies. TVA supplies power to 160 municipal and cooperative electric systems which in turn distribute power to more than 2.3 million customers. Included in these municipal systems are cities such as Chattanooga, Huntsville, Knoxville, Memphis, Murfreesboro, Nashville, and Scottsboro; and among the cooperative systems are the Appalachian, North Alabama, and Sand Mountain Electric Cooperatives. Among the large industries served directly are the Aluminum Company of America, Amoco Chemicals Corp., B.F. Goodrich Co., Bowaters Southern Paper Corp., Consolidated Aluminum Corp., Firestone Tire & Rubber Co., Monsanto Co., Revere Copper and Brass, Inc., Reynolds Metals Co., Texas Eastern Transmission Corp., Union Carbide Corp., and U.S. Steel Corp. The Federal agencies served directly by TVA include The Marshall Space Flight Center of NASA at Huntsville, Alabama, the Arnold Engineering Development Center of the Air Force at Tullahoma, Tennessee, and the AEC plants at Oak Ridge, Tennessee and Paducah, Kentucky.

The Federal Power Commission has designated the TVA system as Power Supply Area 20 and lists the major geographical electric load centers on the TVA system as Memphis, Nashville, Columbia, Chattanooga, Knoxville—all in Tennessee— and Paducah, Kentucky, and Huntsville, Alabama.

TVA is a member of the Southeastern Electric Reliability Council (SERC)[a], which was established in January 1970 as one of the nine members of the National Electric Reliability Council (NERC). The purpose of NERC is to encourage improvement in the coordination of bulk electric power systems at both the national and regional levels.

The SERC Region is bordered by other NERC members as follows (see figure 1-1): (1) on the northeastern perimeter by the Mid-Atlantic Area Coordination Group (MAAC), (2) on the northern border by the East Central Area Reliability Coordination Agreement (ECAR), (3) on the northwestern corner by the Mid-America Interpool Network (MAIN), and

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a. The activities of SERC are described in Southeastern Electric Reliability Council, Coordinated Bulk Power Supply Program 1974-1993, April 1974.

(4) on the western border by the Southwest Power Pool (SPP). The SERC Region is subdivided into the four major groups which make up the total region. These groups are designated as the TVA, the Southern, the Florida, and the Virginia-Carolina (VACAR) subregions. The TVA subregion of SERC consists of the TVA system, the Big Rivers Electric Corporation (Big Rivers EC), and the Henderson Municipal Power and Light Company (Henderson MP&L). The TVA system capacity is approximately 23 times the combined capacity of Big Rivers EC and Henderson MP&L. Due to the size of the TVA system in comparison with the other two systems of the TVA subregion, any subregion or area report of the reliability council is essentially the same as that of the TVA system.

TVA is not a member of any power pool.

TVA is interconnected at 26 points with neighboring utility systems. These transmission connections between systems with peak load requirements occurring during different seasons of the year permit agreements between systems which can reduce the reserve capacity that each system must maintain to achieve the necessary level of reliability. These agreements for the interchange of power are called "diversity interchange agreements." TVA, a winter peaking system, has such interchange agreements with these utility groups whose peaks occur in the summer months. In 1965 TVA reached an agreement with Mississippi Power & Light Company for the exchange of power. The diversity interchange agreement with Mississippi Power and Light Company is for 1,500 MW electrical. In addition, agreements have been reached with the Southern Company for 300 MW electrical and Illinois-Missouri Group for 260 MW electrical of exchange power. This interchange power of 2,060 MW electrical is considered by TVA to be firm generating capacity during its peak season and is accounted for in that manner in all generation planning studies[a].

1.1.1 Load Characteristics - The TVA peak load in calendar year 1973 occurred on January 12 at 8 a.m. when a demand of 18,888 MWe was met by the system. At the time of this peak load, TVA had 20,586 MWe of installed generating capacity which included 16,223 MWe of thermal electric power plants and 4,363 MWe of hydroelectric capacity. The load data are shown for the TVA system in Table 1-1. Over one-third of the homes in the TVA region are electrically heated; and therefore, the energy use for a given period is very weather sensitive. For example, the use shown in Table 1-1 for 1971 reflects a very mild winter as compared with the previous year.

Annual peaks grew at a compound rate of 5.0 percent in the 1964-73 period. The predicted growth rate for the 1974-84 period is 6.5 percent. The combined load of two large AEC installations served by TVA declined from 2,784 megawatts at the hour of the peak in 1964 to 1,941 megawatts in 1973. With these large loads excluded, historical TVA system peaks experienced a growth rate of 6.8 percent while the predicted growth rate is 6.4 percent.

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a. A detailed description of these arrangements is given in Tennessee Valley Authority X17-20 (Hartsville) Nuclear Plants, Information Requested by the Attorney General for Antitrust Review, Submitted AEC February 15, 1974.

The apparent expected large load increase from the annual peak of 1973 to 1974 is due to a large increase expected in the AEC loads served by TVA and from the fact that the peak for calendar year 1973 occurred in January while the peak for calendar year 1974 is expected in December. Thus, there are almost two years of load growth between the two peaks.

TVA's interruptible load under contract is utilized as an operating reserve (interruptible on 5-minute notice). The purpose of this type of interruptible load is to provide operating flexibility at the time of the system peak to cover contingencies such as sudden large demand increases resulting from corresponding change in temperature at the time of the system peak and for offsetting the effects of loss of spinning reserve as a result of an instantaneous loss of a large unit.

TVA has three basic types of interruptible power under contracts with large industrial customers served directly by TVA. The types are 2 percent, 2.5 percent, and 3 percent interruptible power. TVA has the right to curtail power 2, 2.5, and 3 percent of the time during the respective 10-year contract periods. As of July 1, 1974, TVA had under contract 254,800 kW of 2-percent interruptible power, 449,500 kW of 2.5-percent interruptible power, and 275,000 kW of 3-percent interruptible power.

Generation planning by TVA is based on the system's peak load requirements which occur during the winter months. The 2,060 megawatts which TVA and the surrounding utilities exchange on a seasonal basis is considered by TVA to be firm generating capacity during its peak season, thereby saving this amount of installed capacity.

Table 1-2 lists the power and energy exchanges between TVA and the other utilities. The energy deliveries reflect the total diversity interchange as well as purchases and sales.

TVA's capacity planning studies show that base load nuclear generation is the most economical form of generation to add in this time period. Adding baseload generation has significant environmental and economic advantages over adding peaking plants to the system because the base load alternative results in much less operation of TVA's older, less efficient, more costly fossil units. The extent that these coal-fired units will be used as base load during this period will be governed by future systems need, fuel costs, fuel availability, etc.

Estimates of future electrical loads on the TVA system are prepared by TVA considering numerous factors which may have an impact on future growth, including past load trends. Electrical forecasts are made by type of service category such as residential, commercial, industrial, and Federal agency loads for several geographical regions within the TVA system. Each of these categories is individually examined with consideration given to factors which influence their demand for electricity. For example, residential demand for electricity is based on factors such as population, number of households, customers per household, saturation of appliances, and annual uses of appliances. The other classes of service categories are similarly analyzed to estimate the total demand for electricity on the TVA system.

The effect of conservation including price, substitution of electricity for scarce and expensive fossil fuels, and the effect of energy shortages in other regions are weighed and factored into the various load categories in arriving at the total forecast.

Historically, TVA programs have aimed at the most efficient uses of electricity, which is basically a conservation approach. For example, programs have emphasized the need to install adequate insulation in buildings, especially homes. Working with TVA, local distributors of TVA power have pressed hard for installation of insulation when serving electrically heated homes. Consequently, the approximately 800,000 electrically heated homes built in the TVA area in approximately the last 25 years are rather well insulated relative to homes heated by other sources. An intense effort was initiated in 1971 to further promote the use of insulation in all building construction in the Tennessee Valley. TVA submitted proposed insulation standards which are now being considered for enactment into law by the Tennessee legislature (Senate Bill No. 1687). Before the oil embargo, the conservation program emphasized prudent, efficient use of electricity.

Present programs emphasize reducing electrical usage while continuing to stress efficient use. These include much greater emphasis on power factor improvement; more efficient lighting and heat recovery systems in industry; proper regulation of heating, cooling, and ventilation in business and industry; and lower thermostat settings in winter and higher settings in summer in the residential, commercial, and industrial sectors. They also include a heat pump certification program with associated TVA-sponsored installation and service schools and discussions of equipment deficiencies and improvement suggestions with heat pump manufacturers. Public education with more stress on the need to conserve and how to conserve has been stepped up sharply.

An emergency curtailment program has been implemented for the period October 1974 through March 1975 because of declining coal inventories and the threat of a United Mine Workers strike. The program calls for voluntary emergency curtailments of 20 percent among domestic and small business and industry customers. The program consists of wide use of the press, radio, and television to explain the decline in TVA coal inventories, the need to stop the decline in coal inventories, how to conserve electricity, and the necessity for some forms of mandatory curtailment in the event consumers do not respond sufficiently or a coal strike occurs. The 160 municipal and cooperative distributors of TVA power are directly involved in this program and are offering technical assistance as well as speaking to civic groups, schools, and local government officials. Discussions with energy offices in the seven states in which TVA power is distributed were made an integral part of this program to enlist state support and to exchange conservation ideas.

Several important factors restrained electricity usage in the TVA area during fiscal year 1974. Actual sales by TVA of 106.1 billion kilowatthours were 11.6 billion below the forecast of sales completed as the fiscal year began. The most important factor was a short fall in

sales to Federal Agencies which were 6.6 billion kilowatthours less than predicted, with virtually all of this sales shortfall in deliveries to A.E.C. Mild summer and winter weather caused a shortfall of about 2 billion kilowatthours as space heating and cooling loads were below normal levels. A further shortfall of about one billion kilowatthours occurred in sales to industry, probably in connection with recessionary forces and materials and energy shortages. Conservation effects accounted for the remainder of the annual shortfall.

Energy conservation efforts in the TVA area in fiscal year 1974 had a significant but somewhat indeterminate effect upon regional electric usage. Emphasis on conservation at the national level increased public consciousness and effectiveness of conservation information. In general, the effects of the national energy conservation policy and aggressive conservation programs in the TVA region were mutually supporting and cannot be identified separately. The combination of TVA conservation programs, national appeals for conservation, and the gasoline shortage and associated reduced motel and other tourist loads resulted in about two billion kilowatthours less usage, virtually all of it during the past heating season and virtually all of it in municipal and cooperative loads. With sales adjusted to normal weather, the effect of the reduced usage, together with some shortfall in expected industrial loads, was to eliminate growth in sales to municipalities and cooperatives during the period from December 1973 through April 1974 compared to the same period for a year earlier. Recent figures indicate that growth in sales to municipalities and cooperatives has recovered only slightly. Sales during June, July, August, and September, were about 1 percent higher than sales in the comparable period a year ago.

Higher electricity prices had no identifiable effect upon load during the past year. While price is one of the long-run determinants of usage, any price effect which may have developed in the short-run tended to reinforce conservation programs and may have been offset by accelerated customer growth, declining availability of natural gas, rapid price increases in fossil fuels, energy shortages in other regions, other factors, or all of these combined. After adjusting for the effect of mild weather, there was no apparent diminution of load growth in any of the broad categories of load until the energy crisis in the fall of 1973. Further an area record in new and expanded industrial announcements was set in calendar year 1973, and announcements during the first half of calendar 1974 exceeded those of the same period a year ago. In addition, industrial inquiries for power reached an all-time high in the first few months of calendar 1974.

The conservation effect may be defined as a reduction in expected usage in some future year due to such factors as price, institutional changes, public appeals, and consumer education. In practice, it is difficult to identify the contributions of various motives to individual conservation actions. Current price, to the degree that it changes faster or slower than the price level, can be expected to affect future usage. However, identification of the price effect among

other conservation factors may not be attainable on a practical basis. The literature on price elasticity of electricity contains considerable disagreement among authors. In addition, available studies were necessarily performed with data for years when alternate energy forms were plentiful. A major determinant of price elasticity is the availability of substitutes; current and expected shortages of natural gas, the major competitive energy source, and the shock effect of the recent oil embargo would reasonably be expected to reduce the price elasticity of electricity. Thus real price increases can be expected to have little short- or intermediate-term effect on usage except as they support conservation efforts. In addition, sharp rises in all directly used fossil fuels prices will counteract much of the effect of expected electric price increases. Finally, the TVA area can reasonably be expected to retain a long-standing locational advantage for industry in part because present rates are substantially below the national average and the Nation is generally subject to the same kinds of utility cost pressures as the TVA area.

The current load forecast is modified by estimates of the likely conservation effect. The amount of the effect in terms of load is considerable and increases over time. For example, the estimated conservation effect is nearly 3 billion kilowatthours in fiscal 1975 and rises to nearly 10 billion kilowatthours in fiscal 1983. These estimates are subject to modification as conservation experience accumulates over a period of years.

Largely offsetting conservation, the TVA area substitution effect is expected to influence future loads significantly also. The substitution effect may be defined as the replacement of scarce and expensive coal, gas, oil, and LP gas by electricity in residential, commercial, and industrial applications. Initially, the substitution effect will occur in new loads, with shifts from other fuels among existing customers lagging behind new customers. This effect was roughly estimated at nearly 2 billion kilowatthours in fiscal 1975 and about 7 billion kilowatthours in fiscal 1983. These estimates are also subject to modifications as experience accumulates.

Despite the net decline in the forecast due to the excess of conservation over the area substitution effect, the current forecast is higher in the early Eighties than the forecast prepared in the summer of 1973 because of the surge of industrial announcements, the sharp rise in inquiries for industrial power, shortages and rising prices of fossil fuels, and accelerated customer growth in the past 3 years. A significant portion of this surge is associated with the fact that TVA area rates are well below national levels as in the past and with shortages of fossil fuels and electricity in other regions.

The TVA Act specifies that revenues shall recover all costs and provide such margin as the Board may consider desirable in the context of the primary objective of the Act; thus TVA rates are basically cost oriented, with consideration given to preference customers and other non-cost provisions of the Act. The TVA has not changed rate structures

in any significant degree during the past several years, although adjustments to recover rising fuel, money and other costs have been put into effect. Any restructuring of rates would generally follow changes in cost trends, within the guidelines of the Act. The effect of any such restructuring is as yet undeterminate, in some degree because there is little appropriate experience upon which to base predictions. However, any effect of structural changes could reasonably be expected to be slight within the time frame of the Hartsville plant because change in the mix of costs will probably be gradual and the entire effect upon usage of price changes in various charges of the rates would be attained over a long period of years rather than in the short-run.

1.1.2 Power Supply - TVA's generating capacity planning method is based on probability techniques according to the current state-of-the-art. The techniques (see Section 1.1.3) are used to determine the generating capacity required to supply the load requirements plus reserves with a system reliability in terms of the number of days per year that the system load may be expected to exceed the available generating capacity.

TVA plans for generating capacity additions to provide the reliability of bulk power supply in accordance with a probability risk commonly termed the index of reliability. TVA, along with most other utilities, uses an index of one day in ten years. This means that one day in ten years (0.1 day per year) the system load can be expected to exceed the available generating capability.

Therefore, TVA's generating capacity planning criteria is to provide a reasonable assurance that sufficient capacity will be available at the time of the system peaks such that the probability of risk will not exceed the acceptable index of reliability.

TVA's power generating facilities in service on January 1, 1974, included 29 hydro plants, 12 steam plants (including the Allen Steam Plant leased from Memphis), and 2 gas turbine installations. Twelve hydro plants owned by subsidiaries of the Aluminum Company of America and 8 hydro plants of the United States Army Corps of Engineers are operated in coordination with the TVA system. Most of the power from the plants of the Corps of Engineers is supplied to TVA at points of generation. All of the power from the plants of the ALCOA subsidiaries is supplied to TVA at the points of generation under contractual arrangements pursuant to which TVA supplies the power requirements both of ALCOA and of an ALCOA subsidiary which operates a distribution system in western North Carolina.

Table 1-3 shows the TVA system capabilities (including ALCOA subsidiaries and U.S. Corps of Engineers) as of January 1, 1974. Table 1-4 shows future unit additions to the TVA system for the 1974-1984 period. No plans have been finalized for the additional generating units beyond the Hartsville units.

1.1.3 Capacity Requirements

1.1.3.1 Method and Criterion Employed to Determine the Minimum System Reserve Criterion - TVA uses the "loss of load" method as a means to determine generating capacity to supply load requirements plus reserves. The method, a probability technique, is well documented in the literature[a] and is widely used throughout the electric utility industry for capacity planning.

TVA's generation planning criterion and method determines the amount of capacity required to provide a reasonable assurance that sufficient capacity will be available at the time of future system peaks so that the probability of risk will not be greater than the acceptable index of reliability (0.1 day per year) for a reliable supply of bulk power.

Generation planning on the TVA system is made on a month-by-month basis and is based on the expectation that no maintenance will be scheduled during the winter and summer peak months of January and August, respectively. For present TVA system characteristics, planning sufficient capacity to meet the load plus reserve requirements for the peak months at the same time provides load plus reserve requirements with sufficient margin to perform maintenance in the offpeak months.

Seasonal capacity exchange under contract is reflected in TVA planning studies as an adjustment to the system load model. The reserve requirements for the exchanged capacity are provided for by the supplying system.

1.1.3.2 Effect of Operation of the Proposed Nuclear Units on the TVA System - The TVA power system is a winter and summer peaking system with the highest annual peak loads in the TVA area occurring between November and March. Due to seasonal exchange arrangements with other power systems, however, the summer and winter peak loads which the TVA generating capacity must actually serve are not significantly different for this time period. The following tabulations indicate TVA's expected power supply outlook during the 1981-1982 peak load seasons based on the current capacity installation schedules.

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a. See, for example, Application of Probability Methods to Generating Capacity Problems, AIEE Transactions, pf. III (Power Apparatus and Systems), Vol. 79, 1960, pp. 1165-82.

Period	Estimated Peak Demand TVA System MW	Interchange Delivered (Received) MW	Load Served by TVA-MW	Dependable Capacity MW
Winter 1980-81	31,300	-2,060	29,240	35,877
Summer 1981	28,050	+2,060	30,110	36,958
Winter 1981-82	33,100	-2,060	31,040	38,217
Summer 1982	29,450	+2,060	31,510	39,298

	Margins				
Period	Desired MW	Desired %	Available MW	Available %	Surplus (Deficiency) MW
Winter 1980-81	6,754	23.1	6,637	22.7	-117
Summer 1981	6,715	22.3	6,848	22.7	133
Winter 1981-82	7,201	23.2	7,177	23.1	-24
Summer 1982	7,027	22.3	7,788	24.7	761

The above power supply projection is based on assuming commercial operating dates of the proposed Hartsville Nuclear Plant units of December 1980, June 1981, December 1981, and June 1982. If the interchange deliveries were not available during this period, TVA would need to install at least two additional generating units the size of the Hartsville units.

1.2 Other Objectives

TVA has no plans for objectives to be met by this project other than those described herein.

1.3 Consequences of Unit Delays

Based on current projections, the power supply situation for the period during which the Hartsville units are scheduled to become commercial is expected to be extremely tight, even if the current projected schedules of capacity additions are achieved. Any delay in

operation of the Hartsville units could result in the inability of the TVA system to adequately meet its load obligations and jeopardize the reliability of TVA's bulk power supply.

The following tabulation indicates the amounts by which reserves on the TVA system will be inadequate during the peak load seasons, postulating a delay of 6 months and 12 months for each of the Hartsville units (a delay in unit 1 results in an equal delay in the other units):

Period	Megawatt Deficiencies in TVA System Reserve Due to Unit Delays of: 6 Months	12 Months
Winter 1980-81	1,258	1,258
Summer 1981	1,006	2,146
Winter 1981-82	1,163	2,271
Summer 1982	377	1,547
Winter 1982-83	-	972

Deficiencies of the magnitude caused by delays of the Hartsville units must be replaced either by installing alternative capacity on the TVA system or importing power from other utility systems; otherwise, the reliability of power supply to TVA's customers will be drastically reduced. By the time delays in the Hartsville nuclear units would be confirmed, it is unlikely that additional capacity other than short lead-time generating capacity could be installed to meet these deficiencies. Power in the magnitude being considered is not expected to be available from other utilities when it would be needed on the TVA system.

The economic costs of any Hartsville delays (which must ultimately be borne by the consumer) would consist of the cost of replacement capacity and increased production expense during the delay period because of unavailability of low-cost base-load nuclear energy.

As a measure of the cost of replacement capacity, the estimated investment cost of 1,000 MW of replacement capacity which could be installed for the 1980-82 period is approximately $150 million (based on 1980 dollars). Annual fixed charges of about $15 million on such an investment must be borne by consumers in the form of higher rates until the effect of these additions can be absorbed in later years by system growth. The value of these fixed charges (8-percent discount rate and a discount period of 4 years) would be about $50 million.

Fuel, operating, and maintenance expense for the Hartsville nuclear units is estimated to cost about 3 mills per kWh during the 1980-82 period, while replacement energy which would be used in lieu of this nuclear energy in the event of delays would cost from 8 to 28 mills

per kWh, depending on the source of this replacement energy. Studies of the effects of Hartsville unit delays indicate that each month's delay of these units would result in increased production expenses on the TVA system. The magnitude of the increase in production expense would depend on the length of the delays. As a result of a 6-month delay the TVA power system would be reduced by the capacity of one unit for each month in the period--December 1980 to December 1982. If each unit is delayed 12 months from the current schedule, TVA would be without the capacity of one unit for two 6-month periods and two units for three 6-month periods. In months where TVA is without one unit the production expenses would increase by approximately $4 million per month, and approximately 300,000 tons of additional coal and approximately 3.3 million gallons of oil would be consumed.

In summary, delays of the Hartsville Nuclear Plant will have a twofold effect on the TVA power system: (1) Increased operation of TVA's older, less efficient fossil-fired units would be required during the period of Hartsville delays. Such operation would result in the increased emission of particulates, sulfur dioxide, and other materials into the atmosphere. Costs to TVA's customers would be increased by at least $4 million for each month of delay of one unit, assuming the delay did not require the installation of combustion turbines or combined-cycle units; and (2) If additional generating capacity were required to offset deficiencies due to Hartsville delays, costs to TVA's consumers over and above those operating costs shown above could be increased by $50 million for capacity to offset the delay of one unit.

Therefore, operating and replacement capacity costs could total about $98 million for a 12-month delay of one unit. It should be noted however that a 12-month delay in the project would delay each of the four units 12 months with their associated costs.

The analysis shown in Section 1.1.3.2 shows that TVA cannot carry out its statutory obligation of providing an ample supply of electricity for the TVA region without constructing and operating the generating capacity which will be provided by the Hartsville Nuclear Plant. Even with the Hartsville plant the reliability risk level will be below that which TVA considers desirable during the winters of 1980-81 and 1981-82.

Table 1-1

TVA SYSTEM NET ANNUAL PEAKS
AND ENERGY REQUIREMENTS

C.Y.	TVA Area Net Peak - MW Date	Hour	MW	Energy - Million kWh TVA Area Net Requirements
			Actual	
1964	1-15	8a	12,157	71,300
1965	2-3	8a	12,801	77,710
1966	1-31	9a	14,263	83,200
1967	2-25	9a	14,634	85,429
1968	1-8	8a	15,266	88,800
1969	1-10	8a	15,017	93,190
1970	1-21	9a	16,797	94,978
1971	2-10	8a	16,745	94,109
1972	12-18	9a	17,465	103,096
1973	1-12	8a	18,888	111,978
			Projected	
1974	12		20,350	120,051
1975	12		22,300	132,841
1976	12		23,700	144,060
1977	12		25,300	153,000
1978	12		26,750	160,810
1979	12		28,300	168,930
1980	12		29,900	178,000
1981	12		31,600	186,350
1982	12		33,350	195,670
1983	12		35,450	206,010
1984	12		38,050	223,330

Table 1-2

POWER AND ENERGY DELIVERIES

C.Y.	Interchange Capacity Available[1/] To TVA	Interchange Capacity Available[1/] From TVA	Energy Deliveries[2/] Millions of kWh To TVA	Energy Deliveries[2/] Millions of kWh From TVA
		Actual		
1964	0	0	-	323
1965	0	0	68	772
1966	0	0	428	1,708
1967	0	0	1,138	2,471
1968	1,250	150	1,985	2,746
1969	1,800	150	2,415	3,575
1970	1,800	0	2,335	3,732
1971	1,845	200	2,570	2,707
1972	2,360	0	3,128	2,703
1973	2,360	0	3,835	2,799
		Projected		
1974	2,160	0	4,114	2,799
1975	2,160	0	3,202	2,799
1976	2,060	0	2,799	2,799
1977	2,060	0	2,799	2,799
1978	2,060	0	2,799	2,799
1979	2,060	0	2,799	2,799
1980	2,060	0	2,799	2,799
1981	2,060	0	2,799	2,799
1982	2,060	0	2,799	2,799
1983	2,060	0	2,799	2,799
1984	2,060	0	2,799	2,799

1/ Data for the period 1964-73 were reported on FPC Form 12E as capacity available from sales and seasonal capacity exchange and firm obligation to other systems at time of annual peak demand.

2/ Total calendar year annual energy.

Table 1-3

TVA SYSTEM CAPACITY

(as of January 1, 1974)

Plant	Number of Units		Nameplate Capacity-kW Units	Total
TVA Thermal				
Thomas H. Allen[a]	3		330,000	990,000
Thomas H. Allen (Gas Turbines)	20			620,800
Bull Run	1		950,000	950,000
Colbert	5	2 @	200,000	1,396,500
		2 @	223,250	
		1 @	550,000	
Colbert (Gas Turbines)	8			476,000
Cumberland	2	2 @	1,300,000	2,600,000
Gallatin	4	2 @	300,000	1,255,200
		2 @	327,600	
John Sevier	4	2 @	223,250	846,500
		2 @	200,000	
Johnsonville	10	4 @	125,000	1,485,200
		2 @	147,000	
		4 @	172,800	
Kingston	9	4 @	175,000	1,700,000
		5 @	200,000	
Paradise	3	2 @	704,000	2,558,200
		1 @	1,150,200	
Shawnee	10		175,000	1,750,000
Watts Bar	4		60,000	240,000
Widows Creek	8	5 @	140,625	1,977,985
		1 @	149,850	
		1 @	575,010	
		1 @	550,000	
Total TVA Thermal				18,846,385
TVA Hydro				
Apalachia	2			78,900
Blue Ridge	1			20,000
Boone	3			75,000
Chatuge	1			10,000
Cherokee	4			120,000
Chickamauga	4			108,000
Douglas	4			115,000
Fontana	3			225,000
Fort Loudoun	4			135,590
Fort Patrick Henry	2			36,000
Great Falls	2			31,860
Guntersville	4			97,200
Hiwassee	2			117,100

a. Leased January 1, 1965, from Memphis, Tennessee, Light, Gas and Water Division.

Table 1-3
(continued)

TVA SYSTEM CAPACITY

(as of January 1, 1974)

Plant	Number of Units	Nameplate Capacity-kW Units	Nameplate Capacity-kW Total
TVA Hydro (continued)			
Kentucky	5		175,000
Melton Hill	2		72,000
Nickajack	4		97,200
Norris	2		100,800
Nottely	1		15,000
Ocoee No. 1	5		18,000
Ocoee No. 2	2		21,000
Ocoee No. 3	1		27,000
Pickwick	6		220,040
South Holston	1		35,000
Tims Ford	1		45,000
Watauge	2		50,000
Watts Bar	5		150,000
Wheeler	11		356,400
Wilbur	4		10,700
Wilson	21		629,840
		Total TVA Hydro	3,192,630
Alcoa Hydro			
Bear Creek	1		9,000
Calderwood	3		121,500
Cedar Cliff	1		6,375
Cheoah	5		110,000
Chilhowee	3		50,000
Nantahala	1		43,200
Santeetlah	2		45,000
Tennessee Creek	1		10,800
Thorpe	1		21,600
Minor Alcoa Plants	-		6,240
		Total Alcoa Hydro	423,715
Corps of Engineers Hydro			
Barkley	4		130,000
Center Hill	3		135,000
Cheatham	3		36,000
Cordell Hull	2		66,666
Dale Hollow	3		54,000
Old Hickory	4		100,000
J. Percy Priest	1		28,000
Wolf Creek	6		270,000
		Total Corps of Engineers Hydro	819,666

Table 1-4

TVA SYSTEM UNIT ADDITIONS
COMMERCIAL OPERATION AFTER JANUARY 1, 1974

Date	Plant	Unit	Type	Capability-kW	Function
February 1974	Cordell Hull (Corps of Engineers)	3	Hydro	34,000	Base Load & Peaking
August 1974	Browns Ferry	1	Nuclear	1,065,000	Base Load
October 1974	Browns Ferry	2	Nuclear	1,065,000	Base Load
Summer 1975	Gas Turbine Installation (Proposed)	-	Gas Turbines	1,244,000	Peaking
September 1975	Browns Ferry	3	Nuclear	1,065,000	Base Load
December 1975	Raccoon Mountain	1	Pumped Storage	325,000	Peaking
February 1976	Raccoon Mountain	2	Pumped Storage	325,000	Peaking
April 1976	Raccoon Mountain	3	Pumped Storage	325,000	Peaking
June 1976	Raccoon Mountain	4	Pumped Storage	325,000	Peaking
August 1976	Sequoyah	1	Nuclear	1,140,000	Base Load
April 1977	Sequoyah	2	Nuclear	1,140,000	Base Load
November 1978	Watts Bar Nuclear	1	Nuclear	1,169,000	Base Load
August 1979	Watts Bar Nuclear	2	Nuclear	1,169,000	Base Load
December 1979	Bellefonte	1	Nuclear	1,213,000	Base Load
September 1980	Bellefonte	2	Nuclear	1,213,000	Base Load
December 1980	Hartsville Plant A	1	Nuclear	1,205,000	Base Load
June 1981	Hartsville Plant B	1	Nuclear	1,205,000	Base Load
December 1981	Hartsville Plant A	2	Nuclear	1,205,000	Base Load
June 1982	Hartsville Plant B	2	Nuclear	1,205,000	Base Load
Fall 1982	Undetermined	-	*	1,200,000	Base Load
Spring 1983	Undetermined	-	*	1,200,000	Base Load
Fall 1983	Undetermined	-	*	1,200,000	Base Load
Spring 1984	Undetermined	-	*	1,200,000	Base Load
Fall 1984	Undetermined	-	*	1,200,000	Base Load

*Preliminary--no contracts awarded.

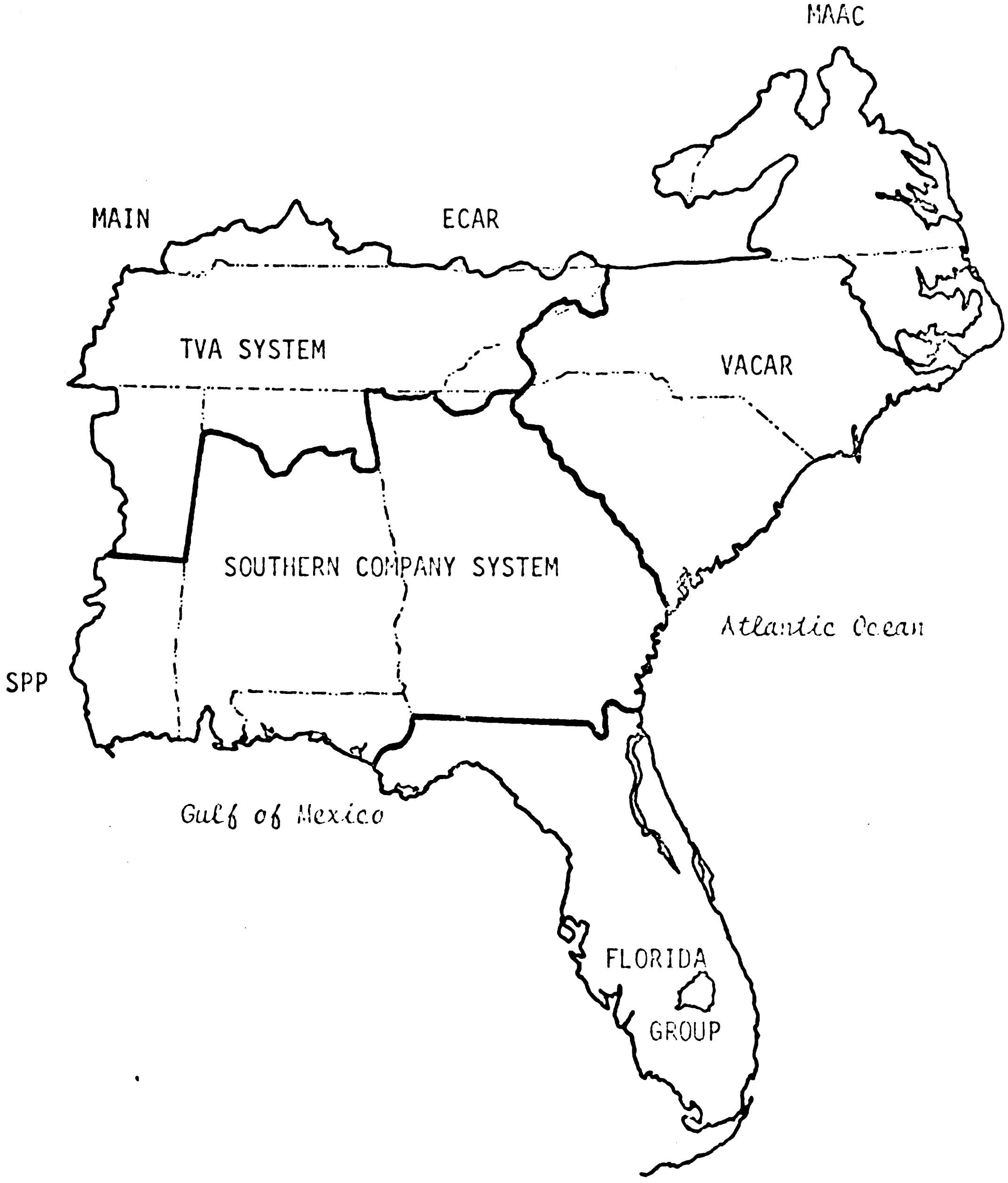

Figure 1-1

SOUTHEASTERN ELECTRIC RELIABILITY
COUNCIL REGION

2.1 Site Location and Layout

The Hartsville site is located in north central Tennessee in Smith and Trousdale counties, approximately 40 miles northeast of Nashville. The nearest communities are Hartsville which is about 5 miles northwest of the site and Dixon Springs which is about 1-1/2 miles east of the site. Figure 2-1 shows the regional location of the plant site and population maps are given in Section 2.2. The site is located on the Cumberland River on the north shore of Old Hickory Reservoir at approximate river mile 285. The site topography is generally low rolling hills with bottom lands along the Cumberland River and the creeks. Figure 2-2 presents general topographic features of the site and surrounding area. Figure 2-3 is an aerial photograph of the site area itself looking in a generally southerly direction. There are no major industrial developments in the immediate vicinity.

The total area of the site is 1,940 acres. Of this area, approximately 300 to 350 acres will actually be utilized for the plant and related facilities.

2.2 Regional Demography, Land, and Water Use

2.2.1 Population Distribution - Population Within 10 Miles - Based on the 1970 Census of Population, an estimated population of slightly more than 12,000 resides within 10 miles of the proposed site (see figure 2-4). Resident population is sparsely distributed with exceptions at Hartsville in Trousdale County (5 miles northwest, population 2,243) and Carthage in Smith County (10 miles southeast, population 2,491) (see figure 2-5). Recreational facilities account for the transient population, and only one is within 3 miles of the site. Estimated peak-hour[a] use at recreational areas within 10 miles of the site show 1,250 for all facilities in 1971 and 2,650 in 2020.

2.2.2 Population Within 50 Miles - The population growth rate during the period 1960-1970 within 50 miles of the site was approximately 14 percent. The 50-mile radius contains all or parts of 27 counties (see figure 2-6), with a population of 891,355[b] (see figure 2-7). Nashville-Davidson County contains a population of 448,444 which constitutes 50.3 percent of the total. Transient population is primarily around the recreational areas surrounding Old Hickory Reservoir.

2.2.3 Future Population - Only slight changes in distribution of population are expected by the year 2020. The sectors which include

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a. Peak-hour use estimates for 1971 based on extrapolation of 1971 annual visitation data obtained from U.S. Corps of Engineers' Nashville District office. Future peak-hour use estimated by TVA Recreation Resources Branch based on projected regional changes in recreation participation as reported in 1969 Tennessee Statewide Comprehensive Outdoor Recreation Plan. Peak-hour estimates based on estimated July 4 levels of use.

b. All population figures based on 1970 Census of Population.

the Nashville area are projected to drop from 53 percent to about 47 percent of the population. Figures 2-8 and 2-9 show projected populations of sectors for the 10- and 50-mile radii respectively. Towns with population greater than 10,000 (1970 Census) are tabulated for comparison with figures 2-4 and 2-7.

City	Distance - Miles	Direction	1970 Population
Lebanon, Tennessee	16	SW	12,492
Gallatin, Tennessee	21	W	13,271
Cookeville, Tennessee	35	ESE	14,270
Murfreesboro, Tennessee	39	SSW	26,360
Glasgow, Kentucky	45	NNE	11,301
Bowling Green, Kentucky	48	NNW	36,253
McMinnville, Tennessee	50	SSE	10,662

Numerous smaller communities and crossroads settlements are dispersed throughout the rest of the region and are surrounded by low-density rural development.

2.2.4 Land Use - Agriculture accounts for 52 percent of the land use and forests account for an additional 37 percent in Smith and Trousdale Counties. Urban development (3 percent of land use) is sparse in the vicinity of the plant site. Old Hickory and Cordell Hull reservoirs comprise the major portion of the remaining 8 percent, with wild life management, other water areas, and miscellaneous land uses comprising the remainder. Industrial development is located almost exclusively adjacent to or in Hartsville and Carthage.

The USDA Land Capability Classification System was used as a basis to inventory the land at the site. The Land Capability Classification System is an interpretative grouping of soils developed by the U.S. Department of Agriculture, in which soils are grouped according to potentials and limitations for sustained production of cultivated crops, pasture, range, or forest over a long period of time. The capability class is a group of capability subclasses and units having the same relative degree of erosion hazard or limitation for agricultural uses. There are eight capability classes, in which limitations of use and risk of soil damage increase as the class designations move from I to VIII.

Figure 2-10 presents a detailed land capability subclass map of the site. Table 2-1 shows the estimated acreages and percentage distribution of land in the Hartsville plant site by land capability subclass. Approximately 65 percent of the land in the plant site is suitable for cultivated field crop production (Classes I through IV).

The majority of land in the plant site is presently in improved pasture. Table 2-2 shows the estimated acreage of crops on the

plant site in July 1974.[a] Very few row crops are presently grown on the site; corn and tobacco are the only important row crops.

Changes in land use are expected to be additional industrial, residential, and institutional expansion around Hartsville and Carthage.

2.2.5 Water Use - Surface water is used for public, industrial, and agricultural water supplies. Table 2-3 shows the public and industrial surface water supplies within 20 miles (7,213,500 gallons/day). Irrigation uses constitute an estimated 52,572,000 gallons/year. Surface water transportation consists of private pleasure craft and is primarily limited to Old Hickory Reservoir. The U.S. Army Corps of Engineers estimates that in 1972 there were 212,000 recreational visits upstream of the site to Cordell Hull Dam and 5,266,000 recreational visits downstream to Old Hickory Dam.

Public and industrial groundwater use within 20 miles of the Hartsville site is 517,600 gal/d. No well in the area could develop a cone of depression large enough to affect the Hartsville site. Within a two-mile radius, groundwater is used for domestic and stock water supplies. Major supplies are as listed below.

	Approximate Radial Distance From Site (miles)	Estimated Population Served	Average Daily Use (gpd)	Source
Public Supply				
LaFayette	13	3,500	281,600	Springs
Red Boiling Springs	19	1,000	160,000	Springs
Watertown	17	1,100	70,000	Wells
Industrial Supply				
J. B. Cassidy LBR	12		2,000	Wells
Cumberland Charcoal	11		4,000	Wells

Total groundwater use: 517,600 gallons per day

2.3 Historical, Aesthetic, and Archaeological Significance

2.3.1 Plant Site and Environs - The plant site is located in a region of moderately rolling hills being utilized primarily as rural farm land. There are no unusual or outstanding land forms or features on the plant site, and TVA is not aware of any present use of this site which would indicate any prospective change from the present aesthetic and cultural aspects of the area related to rural farming.

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a. Estimated after making a reconnaissance of the area and interviewing both Smith and Trousdale County agents.

2.3.1.1 Historical and Aesthetic Significance - The plant site contains no structures currently listed in the National Register of Historic Places (National Register), and no event associated with the site has had significant historic impact.

John McGee, believed to have been the fourth Methodist minister to serve in Tennessee, built a house on this site prior to his death in 1837. This house still stands in good condition, although substantially altered since its original construction. Figure 2-11 shows a view of the McGee house. Reverend McGee is buried on the grounds of his home, and his grave has been marked by the Methodist Church. TVA has acquired title to this house and grounds as a part of site acquisition.

A detailed study of the plant site with respect to its history and architecture was conducted for TVA by a qualified consultant, Dr. James Patrick, from the School of Architecture, The University of Tennessee, Knoxville.

In view of the consultant's report and its own investigations, TVA feels that the house does not meet the criteria for inclusion in the National Register. It is a fine example of a brick farm house of its period, but architecturally, it is not unique. Nor is there integrity of materials and workmanship since the interior of the house has been remodeled since the death of Reverend McGee and few of the original features of the house remain to identify it with its original owner. There are other equally good examples of such architecture in the vicinity of the site. The historical relationship of this site is that associated with the activities of John McGee. The location of this house and grave are within the actual proposed construction site for the plant and therefore will have to be removed. The grave and the marble slabs which mark it will be moved to a suitable site so that appropriate recognition shall continue. While it would be physically possible to move the McGee House to another location, TVA does not believe that it warrants the public investment in funds that would be required for this purpose and, consequently, TVA plans to demolish the house. The house has been photographed and measured according to standard architectural practices and a permanent record of its architecture will be placed in appropriate libraries in the state. Copies of these photos and details of the measurements are available from TVA upon request. If there are groups who have an interest in this structure and would like to consider moving it intact from this site, TVA would be willing to discuss their interest with them.

The consultant also inspected the Wright-Oldham house which is located on the site. TVA concurs with Dr. Patrick that the house is not architecturally significant, and its present condition would likely preclude any efforts at restoration. TVA also concurs that the house should be measured and photographed prior to any dismantling. This house is shown in figure 2-12.

TVA has furnished the Tennessee Historical Commission copies of its reports of studies conducted of historic characteristics of the site. TVA officials have continued to consult with Tennessee Historical Commission officials during the planning stage of this project to assure that proper consideration is given to cultural, historical, architectural, and archaeological values.

One National Register property, Dixona, shown in figure 2-13, is located adjacent to the plant site on the northeast side. Part of the Dixona house dates back to before 1790. This part was built by Tilman Dixon, who received the first land grant for property in this region and was one of the earliest settlers.

Dixon Springs is a relatively intact community about 1.5 miles east of the plant site with examples of structures dating from the early 19th century to the present. The State of Tennessee is considering the nomination of this community to the National Register as a historic district.

Plant construction will have no direct effect on these properties except for increased traffic and noise during construction. The completed plant will have some visual impact on Dixona and Dixon Springs because of its size and proximity of less than two miles. Figures 2-14 and 2-15 show the views respectively from Dixona and Dixon Springs toward the plant. The plant's features which will be visible from these areas have been superimposed on the photographs. To minimize this impact, TVA will work with the community and the state officials to provide, as far as practical, landscaping measures in keeping with the community's setting. TVA will select construction alternatives to reduce this visual impact as much as practical.

Applicable requirements are being followed to determine if any other districts, sites, buildings, structures, or objects are eligible for the National Register which might be adversely affected as a result of plant construction and operation. A discussion of the external appearance of the plant is given in Section 3.1.

2.3.1.2 Archaeological Significance - Archaeological surveys were initiated at the site in September 1972. These surveys were conducted by Dr. Major C. R. McCollough, Assistant Research Professor, Department of Anthropology, University of Tennessee, Knoxville. Other surveys in the general area have been conducted under the direction of Mr. Steven J. Fox, Instructor of Anthropology, Motlow State Community College, Tullahoma, Tennessee. A map indicating the position of known archaeological sites is shown in figure 2-16.

Preliminary surveying and testing, together with a small amount of salvage excavation and investigations, were performed at the Hartsville (Johntown) site during the summer of 1973 under the direction of Dr. R. Bruce Dickson, Assistant Research Professor, Department of Anthropology, University of Tennessee, Knoxville. A preliminary report has been issued and a more comprehensive report is in preparation.

More detailed investigations are currently under way under contract to Motlow State Community College. These studies will determine the exact extent of salvage work necessary.

Plans for investigating and salvaging archaeological material are discussed in Section 4.1.

2.3.2 Transmission Line Rights of Way - To connect the Hartsville Nuclear Plant into the TVA network of power distribution facilities, three transmission line corridors will be required. As shown on figure 2-17, these proposed corridors will be 30 miles, 78 miles, and 86 miles in length with the right of way width varying from 175 feet to 425 feet.

2.3.2.1 Historic and Aesthetic Significance - Corridor 1 passes through an area where land uses generally consist of low-density rural development with Gallatin being the only incorporated area of major population. There are no state or Federal recreation sites in the area traversed by this transmission line corridor. There are several areas of historic interest in the vicinity of the corridor including some structures which have been nominated to the National Register. This line corridor does not encroach on any of these historic areas.

The area adjacent to Corridor 2 is predominately characterized by rural, agricultural, and open space uses. Part of the area is characterized by the rugged western rim of the Cumberland Plateau and is therefore not as likely to develop in the future. The area around Manchester is more suitable for future development and is likely to experience greater developmental pressures due in part to the completion of Interstate Highway 24.

Corridor 2 traverses no state or Federal parks; however, extensive recreation development is projected to occur around the Tims Ford Reservoir located south of the transmission line. Corridor 2 is located to the north of this proposed recreation area. In selecting the route corridors for the proposed transmission lines, the National Register was consulted and no historic conflicts were identified.

Corridor 3 traverses an area which is also predominated by agricultural and open space uses. The three major urban centers of Lebanon, Murfreesboro, and Columbia will be subjected to increasing developmental pressures due in part to their proximity to Nashville and the completion of interstate highways close to their borders. The area around Smyrna is also projected for increasing urban-type densities.[1] Cedars of Lebanon State Park is the only state park located in the vicinity. Major recreation development is planned around J. Percy Priest Dam and reservoir. Corridor 3 passes well south of both recreation areas.

The Tennessee Historical Commission's search for historical sites indicated the possible conflict of Corridor 2 with Fort Nash near Beech Grove and Corridor 3 with two, possibly three, homes in both Maury and Williamson Counties. The exact location of Fort Nash which was built, circa 1792-93, near the junction of two major Indian trails, has been difficult to pinpoint.

Consultation with the Tennessee Historical Commission will continue as the location of the corridors becomes more definite. This will ensure that any potential conflicts between their final locations and any significant historical sites will be given proper consideration.

Following the engineering survey which will provide a definitive location of the line, a professional historian will be consulted.

2.3.2.2 Archaeological Significance - After routes for power transmission lines are established, a professional archaeologist will be consulted to determine if any archaeological resources of significance will be adversely affected by construction activities or the presence of the power transmission facilities. These investigations will be coordinated with the Division of Archaeology, Tennessee Department of Conservation. Should these consultations reveal any significant findings in conflict with the proposed routes, the line locations will be reevaluated.

2.3.2.3 Natural Significance - The most outstanding natural vegetation community of this portion of Tennessee is cedar glades. Cedar glades are found in areas of exposed limestone rock and very little soil. The eastern red cedar is the dominant woody species found in these areas, and many endemic herbaceous species are also found.

Several areas of dense cedars were identified during reconnaissance of the corridors. TVA botanists will determine if any of the areas are true cedar glade communities. If such are identified, appropriate consideration will be given to their protection.

The proposed transmission line corridors cross the Harpeth River and the Duck River. A portion of the Harpeth River from the Rutherford County line northeast of the Cumberland River is designated as a wild and scenic river. Transmission line Corridor 3 crosses the Harpeth River approximately 1/4 mile upstream from the designated section. A 20-mile section of the Duck River below Normandy Dam is scheduled for development as a recreation waterway. Transmission line Corridor 2 traverses this section of the Duck River.

2.4 Geology

The physiographic location of the plant site is on the northeast flank of the Nashville Basin section of the Interior Low Plateaus Province. This elliptical basin, formed on the crest of the Nashville structural dome, occupies the central portion of the state. The erosional basin coincides closely with the structural dome and is surrounded on all sides by the Highland Rim. In the vicinity of the Hartsville site, the rate of erosion and consequent topography have been controlled largely by the Cumberland River. Approximately 425 feet of relief are now present between the floodplain and the tops of hills to the north and east of the site.

Lithologically, the Nashville Basin and surrounding Highland Rim are composed of Ordovician to Mississippian rocks - limestone, shale, and sandstone - typical of the region and lying in normal stratigraphic sequence. Only two formations of Ordovician age will be involved in plant construction; a maximum of 40 feet of the Hermitage Formation and the Carters Limestone with a total stratigraphic thickness of 139 feet.

Topography at the site is low and rolling with the exception of a ridge immediately to the north which rises some 300 feet higher than the proposed plant grade. Except for isolated knolls, the general elevation of the land surface slopes gently toward the river to the south. The surface above approximate elevation 470 is covered to an average depth of 12 feet with residual clay derived from the Hermitage Formation. Depths of alluvial soils in the floodplain area have not yet been determined.

As previously stated, rock at the site will be composed of two basic formations forming a very shallow syncline plunging to the south with a dip of approximately one degree. The upper unit is the Hermitage Formation, a thin-bedded to laminated, sandy and argillaceous limestone interbedded with shale. The preserved thickness varies from 0 to 40 feet depending on surface elevation. Lying unconformably beneath the Hermitage is the Carters Limestone, a medium- to fine-grained, thin- to thick-bedded limestone with shaly partings. The total thickness of the Carters in this area approximates 139 feet. Within the upper zone at about 25 feet below the top, is a 0.6 to 0.8-foot metabentonite horizon consisting of a weakly cemented, granular, siliceous material and some plastic clay.

Differences in lithologic character between the Hermitage Formation and the Carters Limestone, as well as the T-3 metabentonite and other key horizons, are such that excellent structural interpretation is possible. Based on these characteristics and results of the extensive

drilling program, there is no active or capable fault within the vicinity of the major plant structures. The 1966 Geologic Map of Tennessee, published by the Tennessee Division of Geology, does not indicate any fault within a 10-mile radius of the plant.

Permeability of the rock cannot be measured in common terms. Movement of groundwater is controlled completely by bedding plane and joint openings. The frequency of these structural representations is very low in the Hermitage Formation, whereas the upper portion of the Carters Limestone may contain a substantial number, especially where the overlying Hermitage is very thin.

2.5 Hydrology

2.5.1 Surface Water Hydrology

2.5.1.1 Physical Properties - Water elevations of Old Hickory Reservoir vary from a winter elevation of 442(MSL) to a normal summer (also the maximum elevation) of 445(MSL). At maximum pool the reservoir impounds a volume of 420,000 acre-feet, and has a surface area of 22,500 acres. Stream widths vary from 1/2 to 1 mile near Old Hickory Dam to less than 1,000 feet at the Hartsville site (CRM 285).

Water temperature and elevations at the site depend on releases from Cordell Hull and Center Hill (Caney Fork) Dams, causing reservoir stratification. The mean daily flow at the site based on 50 years of records prior to closure of Cordell Hull Dam was 17,000 ft^3/s with a velocity of 1 ft/s.

2.5.1.2 Chemical Properties - Water quality measurements indicate that suspended and total dissolved solids are well below state water quality standards (see Tables 2-4, 2-5, 2-6, 2-7). Analysis of Table 2-8 shows that the average trace metal concentrations of most samples taken at Cordell Hull Dam tailrace at CRM 313.5 meet Tennessee Water Quality Control Board stream guidelines. Concentrations of iron and manganese do not meet guidelines for domestic water supplies.

2.5.1.3 Sanitary Properties - Measurements of fecal and total coliform bacteria, biochemical oxygen demand (BOD), and chemical oxygen demand (COD) indicate that the river is a suitable source of water for the proposed plant. Fecal coliform values are well within state water quality standards. Five day BOD values are generally less than 2 mg/l, and COD is less than 10 mg/l at the sampling locations near the site. The data taken in the vicinity of the site indicates that the sanitary-chemical quality of the water is good.

2.5.1.4 Hydrological Properties - Drainage area of the Cumberland River at the site is 10,903 square miles. The drainage area includes the Poor Fork and Clover Fork which become the Cumberland River at Harlan, Kentucky, the Caney Fork River, South Fork Cumberland River, the Obey River, and the Rock Castle River. Major tributaries to the Cumberland River below the plant site are the Red, Harpeth, and Stones Rivers. Minor tributaries include Round Lick Creek, Goose Creek, and Dixon Creek at the site location. These tributaries experience low or no flow during dry periods.

The flows through Old Hickory Reservoir and water levels at the plant site are controlled by the operation of Old Hickory Dam 68.8 miles downstream from the site and by releases from two upstream dams; Cordell Hull Dam on the Cumberland River at mile 313.5 and Center Hill Dam on the Caney Fork River at mile 26.6. All dams controlling releases into and out of Old Hickory Reservoir are operated for power generation, flood control, navigation, and recreation. During normal operation, releases are made as dictated by the need for peak power. These releases significantly affect flows and the water temperature distribution at the site. Figure 2-18 shows the flow frequency of mean daily discharges at the U.S. Geological Survey stream gage at Carthage, Tennessee (CRM308) based on records from 1951-1970, prior to the closure of Cordell Hull Dam.[2] Under present conditions minimum flows at the site depend on releases from Cordell Hull and Great Falls Dams. Estimated minimum flow at each dam is about 30 ft^3/s from leakage through the turbines during periods when the plants are shut down. During the low-flow season minimum operation of one unit for at least one hour during every 48-hour period is required at Center Hill Dam. At present there are no minimum release requirements at Cordell Hull Dam; however, it is considered unlikely that, during the summer, there will be any days when no turbine releases are made. Due to variation in power loads, it is conceivable that there would be periods of up to 30 hours' duration when the only flow would be leakage and lock releases. Under conditions of no releases from Center Hill, Cordell Hull, and Old Hickory Dams it is probable that flow reversals could occur at the plant site.

Water levels at the Hartsville site may have little or no relation to flows in the river, especially during low-flow periods, since minimum pool levels of Old Hickory Reservoir are based on navigation requirements.

2.5.2 Ground Water

2.5.2.1 Physical Characteristics - The Hartsville site is located near the northern edge of the Central Basin, which is underlain by nearly horizontal limestone strata. Near-surface geologic formations at the site belong to the Stones River Group and the Nashville Group of Middle Ordovician age. These limestone formations are generally poorly water bearing, largely because of the presence of shale beds, shale partings, and shaly limestone. Their ability to receive, store, and transmit water is low.

2.5.2.2 Chemical Properties - The ground water in Smith and Trousdale Counties is hard to very hard (range: 50 to 999 mg/l as $CaCO_3$), and is high in dissolved solids (range: 209 to 1,096 mg/l). Noticeable hydrogen sulfide occurs in 17 percent of the wells in Trousdale County.[3]

2.5.2.3 Hydrologic Characteristics - Water levels vary with well depth. Vertical permeability is believed to be less than horizontal permeability. Areally inconsistent water level is typical of rocks of low permeability. The water table does in general conform to topographic configuration, and has a gradient of about .05 from the site to Old Hickory Lake.

Over most of the site, the water table is below bedrock. Average bedrock porosity (estimated on data from foundation exploration holes) is about 2 percent above 350 feet. The low permeability and transmissibility of these rocks is reflected by well yield statistics for Trousdale County.

2.5.3 Water Quality Standards - Under the provisions of section 401(a)(6) of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. § 1341(a)(6) (Supp. II, 1972)), TVA as a Federal Agency is not required to obtain the certification of compliance with applicable state water quality standards required by section 401(a) of the Act. TVA is, however, required by section 313 to meet state water quality requirements and is subject to Executive Order 11752, "Prevention, Control, and Abatement of Environmental Pollution at Federal Facilities."

2.6 Meteorology

A detailed discussion and data for the Hartsville site are included in TVA's Hartsville Nuclear Plants Environmental Report (Environmental Report).

2.6.1 Regional Climate - The proposed Hartsville Nuclear Plant site is located in a temperate latitude in north-central Tennessee about 450 miles north of the Gulf of Mexico and in a region dominated by the Azores-Bermuda anticyclonic circulation.[4] This circulation is most pronounced in the fall and is accompanied by extended periods of fair weather, widespread atmospheric stagnation and smog.[5] In the winter, the normal circulation becomes diffuse over the southeastern part of the country as the eastward-moving migratory high- or low-pressure systems, identified with the mid-latitude westerly upper circulation, bring alternately cold and warm air masses into the Hartsville site area with resultant changes in wind, atmospheric stability, precipitation, and other meteorological elements. In summer, the migratory systems are less frequent and less intense since the site area is under the influence of the western extension of the Azores-Bermuda anticyclonic circulation with frequent incursions of warm moist air from the Atlantic Ocean and the Gulf of Mexico.

2.6.2 Severe Weather - Severe windstorms may occur several times a year,[6] particularly during the winter, spring, and summer, with winds

reaching 35 mi/h and occasionally exceeding 60 mi/h. The highest wind speed recorded at the Nashville National Weather Service Station, 37 miles southwest of the plant site, was 73 mi/h and the highest peak wind speed recorded at the plant site during the first year (February 1973-January 1974) of operation of the onsite temporary meteorological facility was 50 mi/h. High wind may also accompany moderate-to-strong cold frontal passages 30 to 40 times a year with the maximum frequency in March and April. High wind may accompany thunderstorms, which occur about 55 times a year with the maximum in July.[6] On rare occasions, thunderstorms may cause extensive damage to property from heavy rain (flash floods), lightning, and hail.[7]

Records show that in a 58-year period (1916-1973), there were nine tornadoes reported in Smith and Trousdale Counties where the site is located.[8,9,10] A tornado touched down on April 3, 1974, and crossed the proposed plant reservation along the western boundary (figure 2-19). The tornado's path of destruction was approximately 1,500 feet wide and several miles long. Tornadoes usually move in a northeasterly direction and cover an average surface area of 2.8 square miles.[11] Winds of 150 to 200 mi/h are common in the whirl and are estimated to occasionally reach 300 mi/h. The probability of a tornado at the Hartsville site is .0012, or a recurrence interval of about 840 years.[7,11]

The higher monthly rainfall amounts may occur during winter, spring, and summer. Minimum precipitation normally occurs in October when the regional anticyclonic circulation is most dominant. The maximum recorded 24-hour precipitation was 8.35 inches on August 3, 1893, at Riddleton, Tennessee,[12] about 4 miles southeast of the proposed Hartsville site. Precipitation data since the mid-1950's from both Carthage and the Gallatin Steam Plant station, 18 miles west-southwest of the plant site, have indicated maximum 24-hour precipitation varying between 4.3 and 4.7 inches.

The occurrence of snow or freezing rain, occurring with storms in the midwinter period, is not uncommon. Severe snow or ice storms causing appreciable damage to property and inconvenience to travel may occur on the average of once every 3 years.[13]

Hail storms of significant intensity would rarely occur in the Hartsville site area. The probable recurrence interval of hail (3/4 inch or greater) is about 1,136 years.[7,11,14]

Data[15] show that over a 5-year period, there would be about 30 days that high air pollution potential conditions would likely affect the site area.

2.6.3 Local Meteorology - Because of the shallow valley and surrounding irregular terrain, marked throughout by low rolling hills, there is an absence of pronounced river-valley or valley-ridge features in the proximity of the plant site area. Some minor discontinuities can be expected in the prevailing low-level regional wind because of the higher terrain to the north-northeast through east which slopes

downward into the shallow and elongated east-west valley where the plant site is located. The principal effect of this topographic configuration on the dispersion of gaseous effluent releases from the Hartsville plants would be one of limited confinement within the shallow valley by the weak and stable east and east-northeast down-valley drainage winds. Ground-level concentrations therefore would likely be the greatest in the west and west-southwest downvalley sections. No local wind effects are expected from differential surface heating between land and water because of the narrow Cumberland River as it flows westward along the south boundary of the plant site.

Temperature - The predominant air masses affecting the Hartsville site area may be described as interchangeably continental and maritime in winter and spring, predominantly maritime in summer, and continental in fall. A summary of 89 years of temperature data collected at the Carthage, Tennessee, Cooperative Observer's Station shows a mean annual temperature of 59.3° F. with the mean monthly temperature ranging from 39.4° F. in January to 78.3° F. in July. The highest temperature on record is 111° F. in August and the lowest, -18° F. in February. There are normally 40 days in the year when maximum temperatures are 90° F. and above and 81 days when the minimum temperatures are 32° F. and below at the Nashville National Weather Service station.[6]

Relative Humidity - Representative annual and monthly relative humidity values, based on a 7-year period (1966-1972) of data collected at the Nashville National Weather Service station, show that the average annual relative humidity is 70.3 percent with the average monthly range from 61.3 percent in March to 76.5 percent in August. The 6-hour diurnal distribution of the monthly average value shows that the highest relative humidities occur at 0600 hours central standard time in July, August, and September with respective values of 90,92, and 90 percent. The lowest monthly average is the March 1200 hours local time value of 50 percent.

Precipitation - Precipitation patterns at the Gallatin Steam Plant show that annually there are 110 days with 0.01 inch or more of precipitation. The average annual precipitation at Carthage is 52.49 inches, with the average monthly maximum, 5.79 inches, occurring in December, and the average monthly minimum, 2.72 inches, occurring in October. The extreme monthly maximum and minimum are 13.00 inches in March and 0.51 inch in October, and the maximum 24-hour precipitation in the Carthage area is 8.35 inches in August.

Appreciable snowfall seldom occurs at the proposed Hartsville site. The average annual snowfall at Carthage based on the period 1887-1960, is 7.4 inches and occurs mostly during December through March.

Fog - No observations of the frequency and intensity of fogs have been made in the proposed Hartsville site area. However, Nashville National Weather Service station records for 31 years (1942-1972) indicate that heavy fogs (visibility equal to or less than 1/4 mile) occur about 17 days annually with a maximum monthly frequency of 3 days in January and a minimum of 1 day from February through July and September.

Atmospheric Stability - Meteorological data indicate that stable atmospheric conditions will annually occur approximately 52 percent of the time. Critical stability conditions occur about 17 percent and are normally identified with the weak night downvalley or drainage wind. The expected transitions of atmospheric stability occur as the diurnal temperature pattern fluctuates.

Wind Direction - Data at the onsite temporary meteorological facility for the 1-year period, February 1973-January 1974, are used to identify the expected annual low-level wind pattern in the site area. The annual and monthly 33-foot wind data show predominant east-northeast and northeast winds. The two highest percentages of monthly wind directions are in September and October, both for east-northeast wind. The remaining months also show the prevalent northeasterly component winds which are expected due to the terrain features.

The data also indicate the presence of a local nighttime down-valley or drainage-type wind. The 150-foot wind patterns for the day and night periods are more uniform with the prevailing southeasterly directions and perhaps begin to reflect the higher level regional winds.

Wind Speed - The data show that calms at the low level occurred less than 2 percent of the time; 0.6-3.4 mi/h wind, approximately 38 percent; and 3.5-7.4 mi/h wind, approximately 35 percent. The highest annual frequencies of 0.6-3.4 mi/h wind with respect to direction are about 11 and 6.5 percent with east-northeast and northeast winds, respectively.

The lowest wind speeds, less than 3.4 mi/h, have their highest frequency during the summer through early fall periods when the regional anticyclonic circulation is most common.

Moderate to high wind speeds (equal to or greater than 7.5 mi/h) occur about 25 percent of the time. February through April have the highest frequencies while June through October have the lowest. The highest annual occurrences, with respect to direction, are about 2 to 3 percent with southwest and west winds.

The data show that the lowest wind speeds, less than 3.4 mi/h, occur about 50 percent during the night period and about 30 percent during the day period. Furthermore, the moderate to high wind speed (equal to or greater than 7.5 mi/h) occurs about 33 percent of the time during the day period and about 17 percent during the night period.

2.7 Ecology

2.7.1 Terrestrial - The Hartsville site has been used intensively by man for agricultural purposes for many years. Heavily fenced, it consists primarily of pasture, cropland and understocked woodland. Human activity, particularly cultivation, has continually disrupted plant and animal communities. The site is located in the Nashville or Central Basin physiographic province and is within the western mesophytic forest region.

The vegetation of the Hartsville site has been tentatively categorized into seven arbitrary zones: (a) limestone knolls with mostly closed woods but occasional open spaces; (b) open woods and deciduous tree rows primarily occurring along property lines; (c) pastures; (d) old fields; (e) cultivated areas; (f) fence rows; and (g) riparian woodlands (see figure 2-20).

The site has no unusual terrestrial habitats, primarily because of the relatively intense agricultural activities in the area. There are no river bluffs or caves on the site. The wooded knolls afford the largest amount of terrestrial bird and small mammal habitat. The riparian woodland areas along Dixon Creek, the Cumberland River, and Dixon Island constitute another important habitat type at the site.

In summary, the wooded areas, although quite small relative to the size of the entire site, are expected to support a myriad of songbirds, herpetiles, and small mammals. Fence rows also should support a variety of wildlife species.

No unique, rare, or endangered animal species are know to occur on the site.[16] A rare and endagered plant, marbleseed (Oposmoduim molle), was found in open areas on the limestone knolls. This species will not be affected by plant construction since it is located well outside the areas of plant construction.

2.7.2 Aquatic - Site assessment studies of fish populations were initiated in the fall of 1972. In May 1973, two limnological site surveys were made by TVA to assess the general biological conditions of the area. One survey was to collect general limnological data at three stations on the Cumberland River in the vicinity of the Hartsville site and the other was a preliminary benthic faunal survey of streams located near the site.

Detailed discussions of the nature of both the terrestrial and aquatic communities in the site vicinity can be found in the environmental report submitted to the AEC by TVA on July 1, 1974.

2.7.2.1 Fish - The piscine community near the Hartsville site is a mixture of stream and lake forms as is typical of reservoir headwaters. Four cove samples (Table 2-9) yielded an estimated standing crop of 149.5 to 826.9 pounds per acre. In the four coves gizzard shad were numerically dominant as they were in gill net (Table 2-10) and electrofishing (Table 2-11) samples. Bluegill, carp, and drum were also abundant in cove samples. A total of 35 fish species was collected in the four coves.

2.7.2.2 Other Aquatic Life - Studies revealed a moderately varied phytoplankton and zooplankton community. Diatoms (Chrysophyta) and green algae (Chlorophyta) dominated the phytoplankton. *Keratella crassa* (Rotifera) was the most abundant of 42 zooplankton taxa noted in preliminary site studies.

The benthic fauna community diversity was quite low at all stations. Detailed data can be found in the environmental report.

REFERENCES FOR CHAPTER 2

1. Preliminary Development Plan: 1972-2000 for the Mid-Cumberland Region of Tennessee, Mid-Cumberland Council of Governments and Mid-Cumberland Development District, April 1972.

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Table 2-1

Description of Land - Hartsville Site - By Land Capability Subclass

Land Capability Subclass	Acres	Percent
I	316.22	16.3
IIe	453.96	23.4
IIIe	261.90	13.5
IIIw	27.16	1.4
IVs	184.30	9.5
VIe	42.68	2.2
VIs	166.84	8.6
VIIe	1.94	0.1
VIIs	485.00	25.0
Total	1,940.00	100.0

Table 2-2

Estimated Acreage of Crops at the Hartsville Plant Site, 1974 Crop Year

Crop	Estimate Acres	Normal Yield per Acre
Corn	150-200	100 bushels
Tobacco	55-60	2500 pounds
Hay and Pasture	1,706	1½ to 2 acres per cow-calf unit
Woods	200	
Total	1,940	

Source: Basis for making these estimates was a reconnaissance of the site, interviews with Smith and Trousdale county agents plus some knowledge of our own regarding agriculture in the area.

Table 2-3

Surface Water Supplies Within a 20-Mile Radius
of the Hartsville Site and Supplies Taken from the
Cumberland River between Cordell Hull and Old Hickory Dams

	Water Supply	Approximate Distance From Site[1]	Estimated Population Served	Average Daily Use	Source
	Public Supplies	Miles		Gallons	
1.	Carthage	24.0	3,070	209,000	Surface (CRM 309.0)
2.	Hartsville	6.4	2,500	300,000	Surface (CRM 278.6)
3.	Gallatin	45.8	17,620	2,145,000	Surface (CRM 239.2)
4.	Lebanon	22.1	17,550	2,800,000	Surface (CRM 262.9)
5.	Camp Boxwell	49.0	750	11,000	Surface (CRM 236.0)
6.	Easter Seal's Crippled Children's Camp	49.0	800	5,000	Surface (CRM 236.0)
7.	Old Hickory Dam and Recreation Area	68.8	6,200	43,400	Surface (CRM 216.2)
8.	Whitehouse Utility District	68.5	12,760	40,600	Surface (CRM 216.5)
9.	Old Hickory Utility District	66.0	13,900	973,000	Surface (CRM 219.0)
10.	Smith Utility District	15.0	1,800	531,100	Surface (Caney Fork River Mile 7.7)
11.	Westmoreland	17.0	1,200	125,000	Surface (Reservoir)

Table 2-3
(Continued)

Surface Water Supplies Within a 20-Mile Radius
of the Hartsville Site and Supplies Taken from the
Cumberland River between Cordell Hull and Old Hickory Dams

Water Supply	Approximate Distance From Site[1]	Estimated Population Served	Average Daily Use	Source
Public Supplies	Miles		Gallons	
12. Hendersonville Utility District	63.0	18,500	1,556,000	Surface (Drakes Creek Arm of Reservoir, CRM 222.0)
13. West Wilson Utility District	61.0	9,100	580,000	Surface (CRM 224.0)
Industrial Supplies				
1. Gallatin Steam Plant	41.4	270	5,400	Surface (CRM 243.6)
2. Hugh Dixon LST Co.	12.0		25,000	Surface (Stream)

1. Radial distance to all supplies except those that take water directly from the Cumberland River which are shown as river mile distance from mile 285.0.

SOURCE: Water Use in Tennessee by Counties - 1970, State of Tennessee, Department of Conservation.

Table 2-4

CHEMICAL QUALITY OBSERVATIONS ON THE CUMBERLAND RIVER AT THE HARTSVILLE WATERWORKS INTAKE AT CRM 278.7

Water Years 1960-1966

Water Year	Average Discharge	Hardness as $CaCo_3$	Calcium as $CaCO_3$	Magnesium as $CaCO_3$	Sodium	Potassium	Iron	Chlorides	Sulfates	Dissolved Solids
	cfs	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1960	17,630	72	46	25	2.9	1.3	1.2	3.4	13	93
1961	24,050	87	49	38	2.3	1.2	1.6	4.6	13	81
1962	15,570	75	51	24	2.3	1.3	1.3	5.0	13	90
1963	12,860	83	54	30	2.1	1.5	2.4	5.0	14	76
1964	18,300	86	60	26	2.7	1.6	3.2	4.0	14	88
1965	9,780	92	63	29	3.0	1.4	1.9	3.0	16	85
1966	19,340	84	61	23	3.2	1.4	2.6	4.0	24	101

SOURCE: "Water Quality of Tennessee Surface Streams" (1960-1967), Tennessee Stream Pollution Control Board

Table 2-5

FIELD MEASUREMENTS OF CUMBERLAND RIVER QUALITY AT CRM 308.25

Date	Water Temp.	Dissolved Oxygen	Total Alkalinity as $CaCO_3$	pH	Total Hardness as $CaCO_3$	Color Pt-Co	Turbidity	Total Solids	Discharge
	°C.	mg/l	mg/l		mg/l	Units	JTU	mg/l	ft^3/s
8/ 7/72	17.0	9.1	46	7.6	66	10	15.0	102	11,200
9/ 5/72	16.0	8.7	42	7.5	58	10	17.0	81	6,940
10/ 5/72	15.0	8.2	60	7.6	78	14	9.0	100	6,710
11/ 3/72	15.0	9.5	60	7.4	80	5	4.0	111	10,400
2/ 9/73	--	7.5	34	7.4	76	41	18.0	140	46,600
3/ 5/73	8.0	11.6	--	7.4	64	52	25.0	124	12,500
5/14/73	13.5	10.9	54	7.7	69	78	48.0	100	30,700
6/ 5/73	18.0	9.7	62	7.6	76	36	18.0	103	--
7/30/73	20.0	8.9	49	7.4	63	57	24.0	110	--
9/11/73	19.0	5.7	46	6.6	64	<1	13.0	111	--
12/ 2/58	10.0	9.9	70	7.4	79	11	15.0	134	5,860
1/21/59	7.0	10.8	69	7.3	62	14	35.0	146	15,200
2/ 3/59	8.0	11.1	74	7.2	51	11	10.0	140	8,520
3/24/59	11.0	10.9	58	7.5	86	25	14.0	128	10,100
6/14/60	18.0	9.4	45	7.5	80	5	10.0	125	6,510
9/13/60	17.0	8.9	44	7.5	77	35	12.0	105	5,980

SOURCE: State of Tennessee, Water Quality Control Division, and "Water Quality of Tennessee Surface Streams" (1960-1964), Tennessee Stream Pollution Control Board

Table 2-6

FIELD MEASUREMENTS OF CUMBERLAND RIVER QUALITY AT CRM 263

Date	Depth of Measurement	Water Temp.	Dissolved Oxygen	Total Alkalinity as $CaCO_3$	pH	Total Hardness as $CaCO_3$	Color	Turbidity	Solids
	ft.	^oC	mg/l	mg/l		mg/l	PCU	JTU	mg/l
5-22-73	1	15.5	10.9	43	7.2	66	10	15	111
5-22-73	19	15.5	10.6	47	7.2	63	10	20	108
5-22-73	38	15.5	11.2	46	7.4	63	10	40	153
7-23-73	0	19.7	7.4	40	6.7	61	15	20	101
9-4-73	1	22.0	7.4	42	6.5	58	20	15	86

SOURCE: Tennessee Valley Athority, Water Quality Branch

Table 2-7

FIELD MEASUREMENTS OF CUMBERLAND RIVER
QUALITY AT CRM 244.0

Date	Water Temp.	Dissolved Oxygen	Total Alkalinity as $CaCO_3$	pH	Total Hardness as $CaCO_3$	Color	Turbidity	Total Solids
	$^{o}C.$	mg/l	mg/l		mg/l	PCU	JTU	mg/l
5/22/73	17.5	10.5	45	6.7	67	10	15	119
7/23/73	20.3	8.6	38	6.8	64	15	15	105
9/ 5/73	22.0	7.0	34	6.8	56	10	15	114

SOURCE: Tennessee Valley Authority, Water Quality Branch

Table 2-8

SUMMARY OF OBSERVED TRACE METAL CONCENTRATIONS AND COMPARISON WITH TENNESSEE WATER QUALITY CONTROL BOARD GUIDELINES

Parameter Total	Observed Concentrations at CRM 313.5 May-September 1973 Maximum	Minimum	Mean	Tennessee Water Quality Control Board Stream Guidelines
	µg/l	µg/l	µg/l	µg/l
Iron	1,000.0	600.0	830.0	1,500 300[a]
Copper	<10.0	<10.0	<10.0	20
Zinc	20.0	<10.0	13.0	100
Barium	<100.0	<100.0	<100.0	5,000 1,000[a]
Beryllium	<10.0	<10.0	<10.0	No guideline established
Silver	<10.0	<10.0	<10.0	5
Aluminum	1,600.0	400.0	970.0	1,000
Selenium	<1.0	<1.0	<1.0	10
Arsenic	<5.0	<5.0	<5.0	1,000 10[a]
Manganese	120.0	50.0	90.0	1,000 50[a]
Lead	<10.0	<10.0	<10.0	50
Chromium	<5.0	<5.0	<5.0	50
Nickel	<50.0	<50.0	<50.0	100
Cadmium	<1.0	<1.0	<1.0	10
Mercury	0.6	<0.2	0.3	5

a. Guideline for streams classified for domestic water supply.

SOURCE: Tennessee Valley Authority, Water Quality Branch

Table 2-9

Species composition by numbers and weight of fishes taken by cove-rotenone sampling in the vicinity of Dixon Creek; September 1972 and September 1973.

Species	Percent by Number				Percent by Weights			
	1972		1973		1972		1973	
	A*	B**	A	B	A	B	A	B
Paddlefish	t	0.2	--	--	0.5	1.5	--	--
Longnose gar	t	0.4	t	0.1	t	0.6	0.1	0.2
Skipjack herring	0.4	1.0	t	--	t	0.1	0.1	--
Gizzard shad	87.3	51.9	89.2	91.2	45.3	26.3	71.7	65.7
Threadfin shad	0.3	2.5	1.6	--	t	0.1	0.2	--
Carp	4.4	4.6	1.4	0.2	37.9	27.6	15.7	1.4
Golden shiner	--	0.2	--	--	--	t	--	--
Emerald shiner	--	1.5	--	--	--	t	--	--
River carpsucker	0.1	0.6	0.1	--	0.7	2.9	0.7	--
Quillback	--	--	--	t	--	--	--	0.1
Smallmouth buffalo	0.4	1.3	0.3	0.3	3.1	11.4	3.6	3.5
Bigmouth buffalo	0.6	0.4	t	0.2	6.7	6.0	0.6	3.1
Black buffalo	--	--	--	t	--	--	--	0.6
Spotted sucker	t	0.2	0.2	t	0.2	1.1	1.0	0.1
Black redhorse	--	--	--	--	--	--	--	--
Golden redhorse	0.2	--	0.3	t	0.4	--	1.5	0.1
White sucker	--	0.2	--	--	--	1.1	--	--
Black bullhead	t	--	--	--	t	--	--	--
Yellow bullhead	--	--	t	0.4	--	--	0.1	1.2
Channel catfish	t	0.4	0.1	t	t	2.6	0.5	0.1
Mosquitofish	t	--	--	--	t	--	--	--
Brook silverside	--	--	t	--	--	--	t	--
White bass	t	--	t	--	t	--	t	--
Green sunfish	0.1	--	t	t	t	--	t	t
Warmouth	--	1.3	0.1	0.1	--	0.2	t	t
Bluegill	2.4	20.5	4.5	2.8	0.6	5.5	1.4	0.8
Longear sunfish	0.1	0.4	--	t	t	0.1	--	t
Redear sunfish	--	0.2	--	--	--	0.1	--	--
Smallmouth bass	--	0.2	--	t	--	0.1	0.1	0.1
Spotted bass	t	--	--	--	0.2	--	--	--
Largemouth bass	0.1	--	0.3	0.3	0.6	--	0.6	0.1
White crappie	0.4	2.5	0.4	1.9	0.2	2.8	0.2	0.5
Black crappie	0.3	0.6	0.3	0.1	t	0.4	0.2	t
Sauger	0.2	0.2	0.2	0.1	0.4	0.1	0.2	0.1
Freshwater drum	2.3	8.8	0.8	0.4	3.0	9.4	1.5	0.8
Total Standing Crop (Pounds/acre)	826.9	231.7	149.5	394.4				

*Dixon Creek cove
**Cove 2.5 km (1.6 mi) below the mouth of Dixon Creek
t = Less than 0.05 percent

Table 2-10

RESULTS OF GILL NET SAMPLING ON
OLD HICKORY RESERVOIR NEAR DIXON SPRINGS

Date Net-Nights	9/72 12	9/73 12	11/73 34	1/74* 40	4/74 30
Paddlefish	--	--	--	--	1
Longnose gar	1	7	4	--	--
Skipjack herring	--	--	1	15	14
Gizzard shad	--	--	--	51	55
Threadfin shad	--	--	--	--	1
Mooneye	--	--	1	1	--
Carp	2	4	15	--	--
River carpsucker	3	3	11	1	1
Quillback	--	--	--	--	1
Smallmouth buffalo	--	2	23	2	2
Bigmouth buffalo	--	--	1	--	--
Spotted sucker	--	--	--	1	7
Black redhorse	--	--	--	5	4
Golden redhorse	--	7	1	4	12
Shorthead redhorse	--	2	--	--	--
Channel catfish	--	1	7	14	--
Yellow bullhead	1	--	--	--	--
Black bullhead	--	--	--	--	1
White bass	--	--	--	--	2
Striped bass	--	--	1	--	--
Bluegill	--	3	3	--	--
Redear sunfish	--	1	--	--	--
Largemouth bass	--	--	--	--	1
Sauger	--	--	1	--	1
Walleye	--	--	1	9	--
Freshwater drum	2	2	1	289	16

*All nets on these nights were in the backwater areas of Dixon Creek.

Table 2-11

RESULTS OF ELECTROFISHING ON
OLD HICKORY RESERVOIR NEAR DIXON SPRING

Species	9/72	9/73	4/74
Number of hours of electrofishing	10	0.75	1.5
Longnose gar	2	--	--
Gizzard shad	598	9	149
Threadfin shad	70	--	19
Mooneye	15	--	3
Emerald shiner	--	--	7
Carpsucker	1	--	--
Carp	78	8	1
Smallmouth buffalo	10	2	6
Bigmouth buffalo	1	--	--
Black redhorse	--	1	--
Golden redhorse	--	10	--
Black bullhead	1	--	--
Bluegill	130	7	--
Longear sunfish	30	--	--
Spotted bass	1	--	--
Largemouth bass	3	2	--
Logperch	--	1	--
Walleye	--	3	--
Freshwater drum	3	--	1

Figure 2-1
HARTSVILLE VICINITY MAP
(Site location - 86° 05' 09.8" W, 36° 21' 15.2" N)

Figure 2-2

HARTSVILLE AREA TOPOGRAPHIC MAP

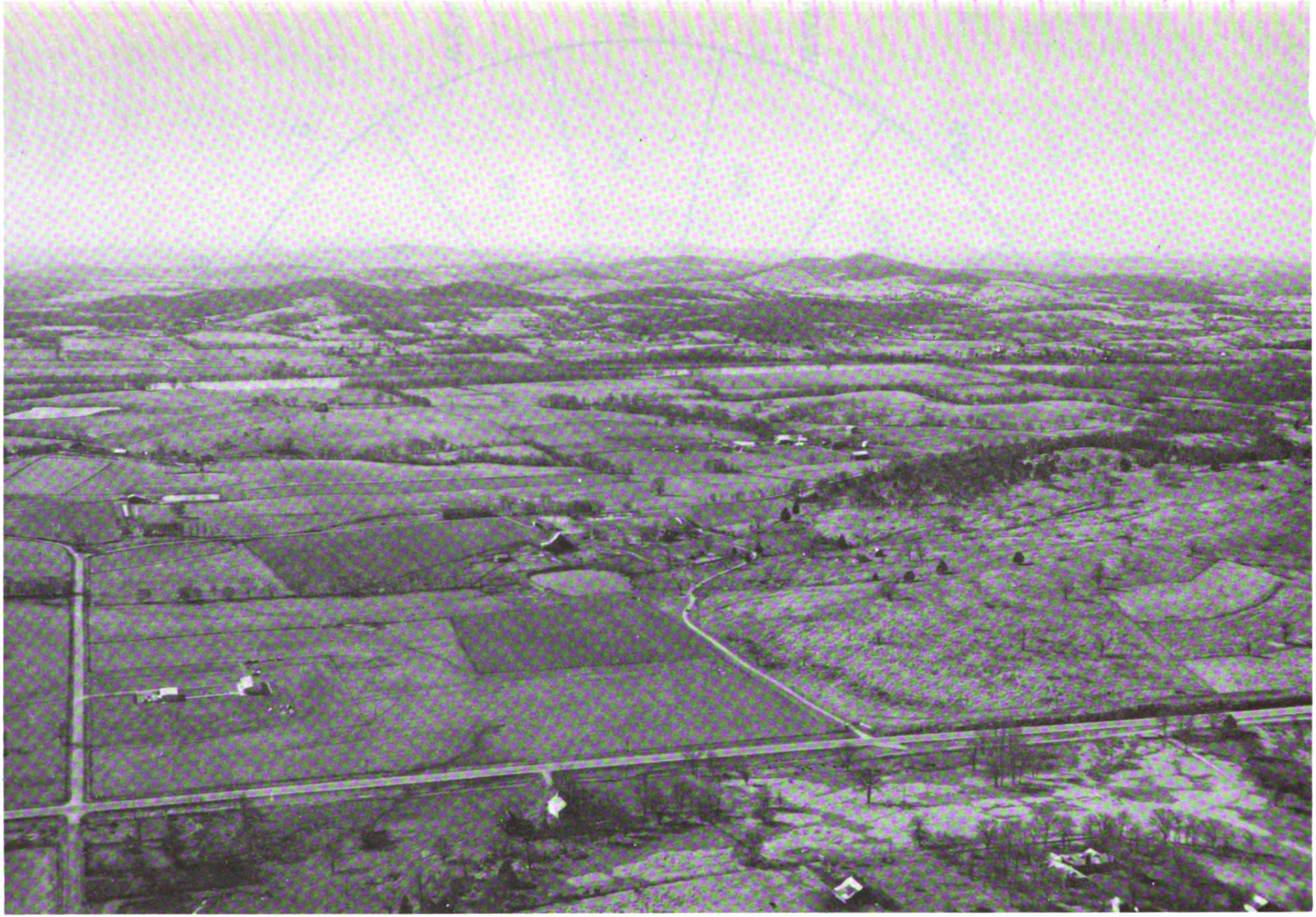


Figure 2-3

AERIAL PERSPECTIVE OF HARTSVILLE SITE

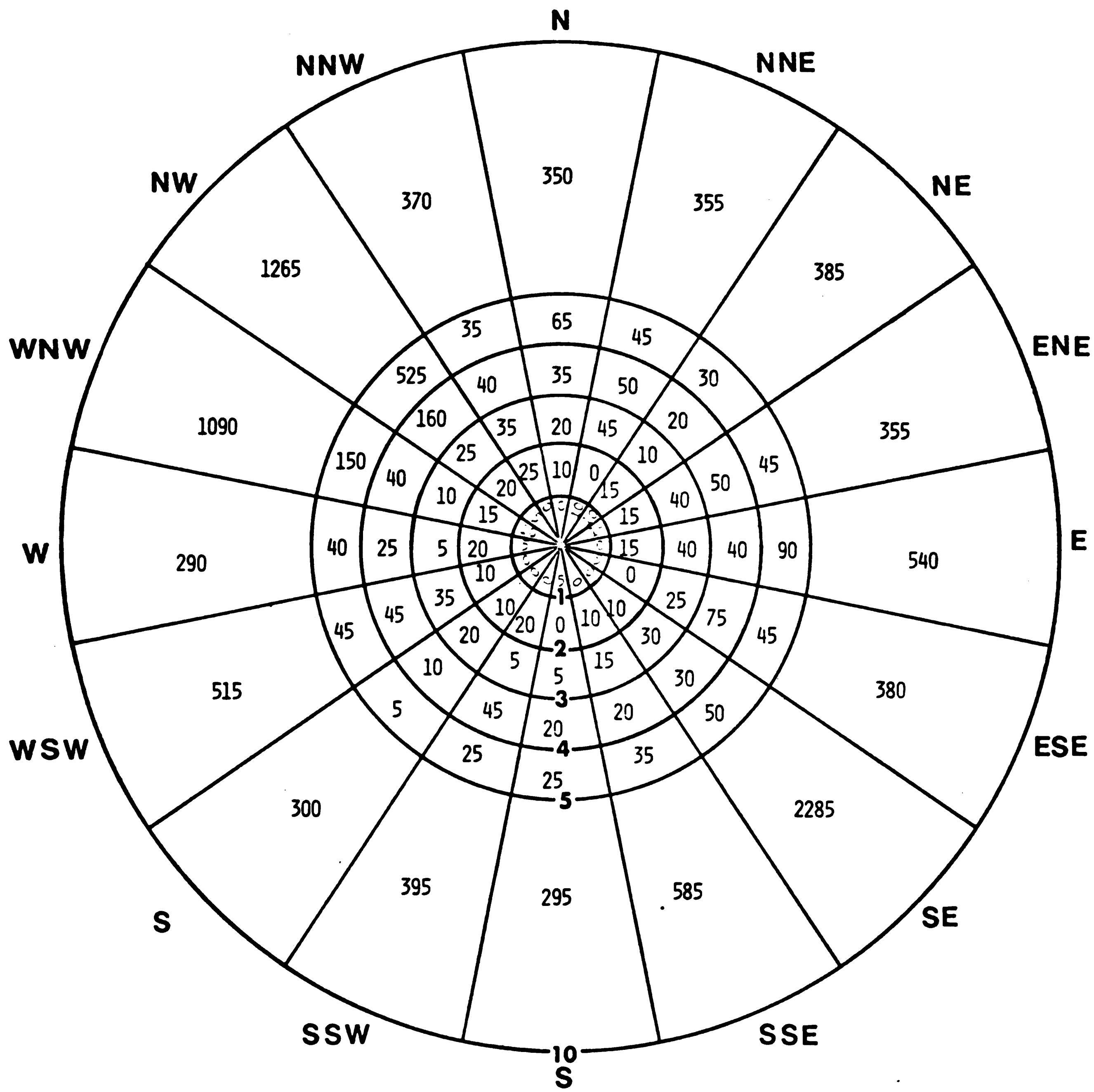


Figure 2-4

POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE
HARTSVILLE PLANT
FOR CENSUS YEAR 1970

Figure 2-5

VICINITY MAP WITHIN
10 MILE RADIUS
HARTSVILLE NUCLEAR PLANTS

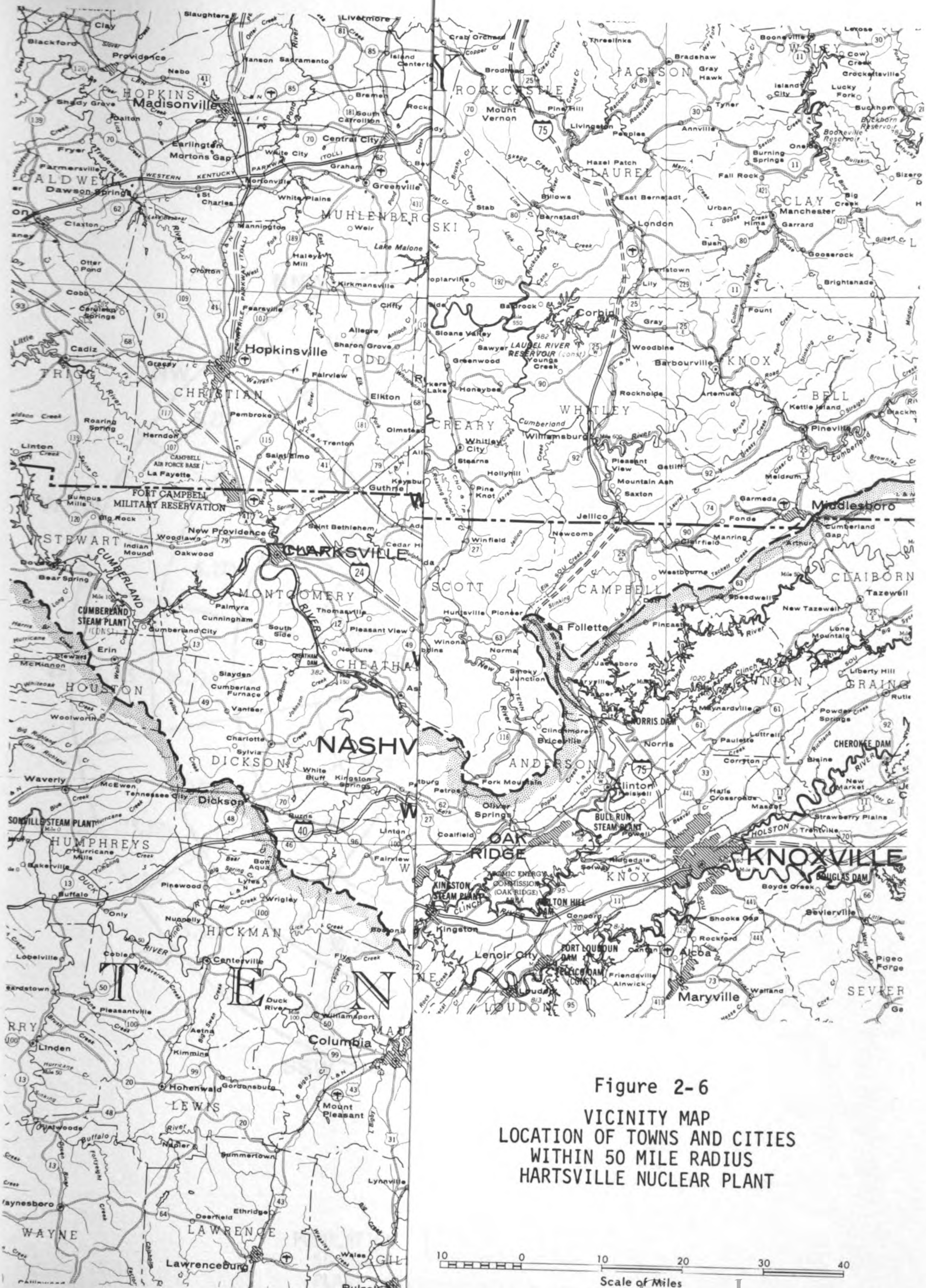


Figure 2-6

VICINITY MAP
LOCATION OF TOWNS AND CITIES
WITHIN 50 MILE RADIUS
HARTSVILLE NUCLEAR PLANT

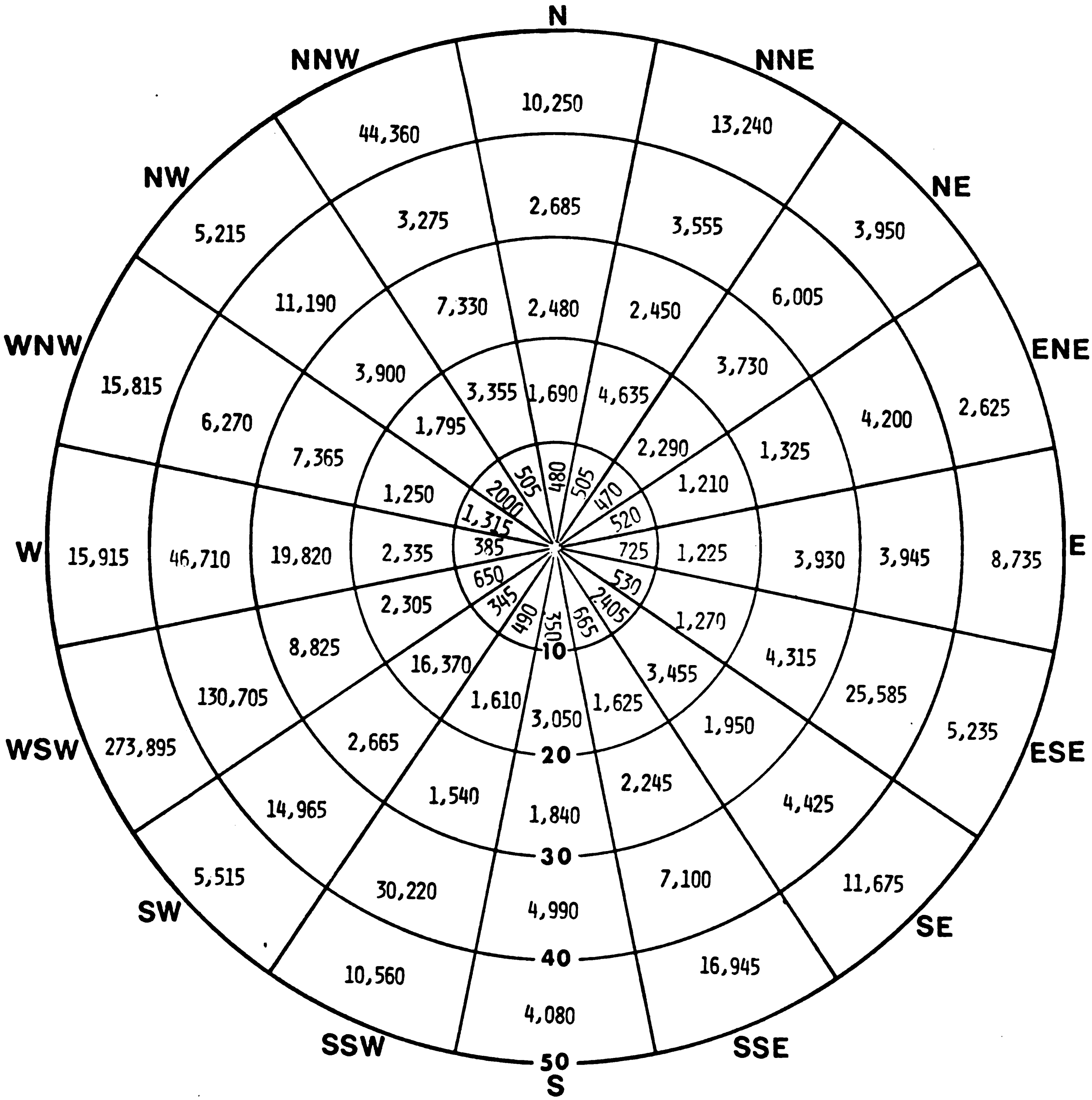


Figure 2-7
POPULATION DISTRIBUTION WITHIN
50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 1970

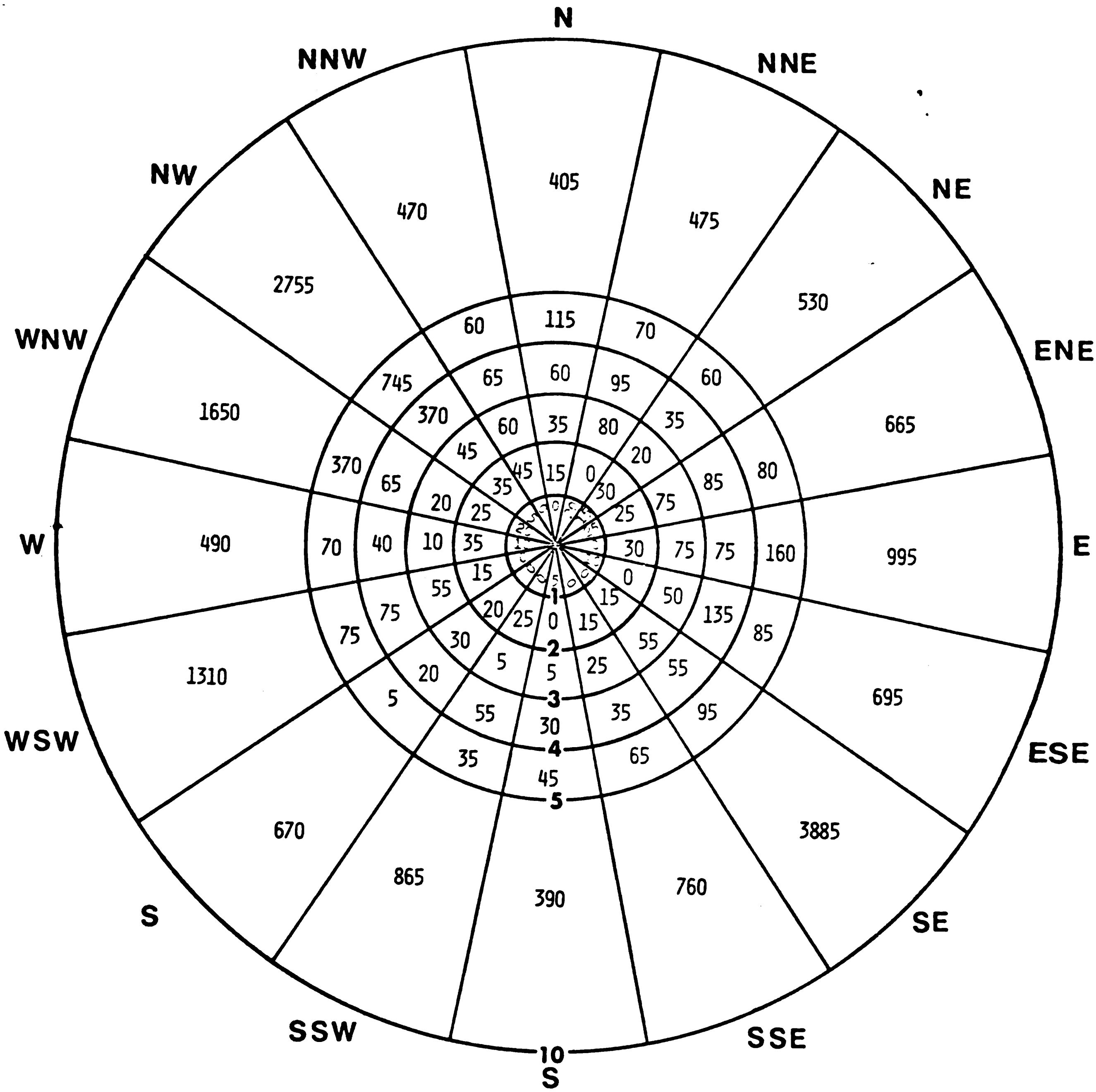


Figure 2-8

PROJECTED POPULATION DISTRIBUTION
WITHIN TEN MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2020

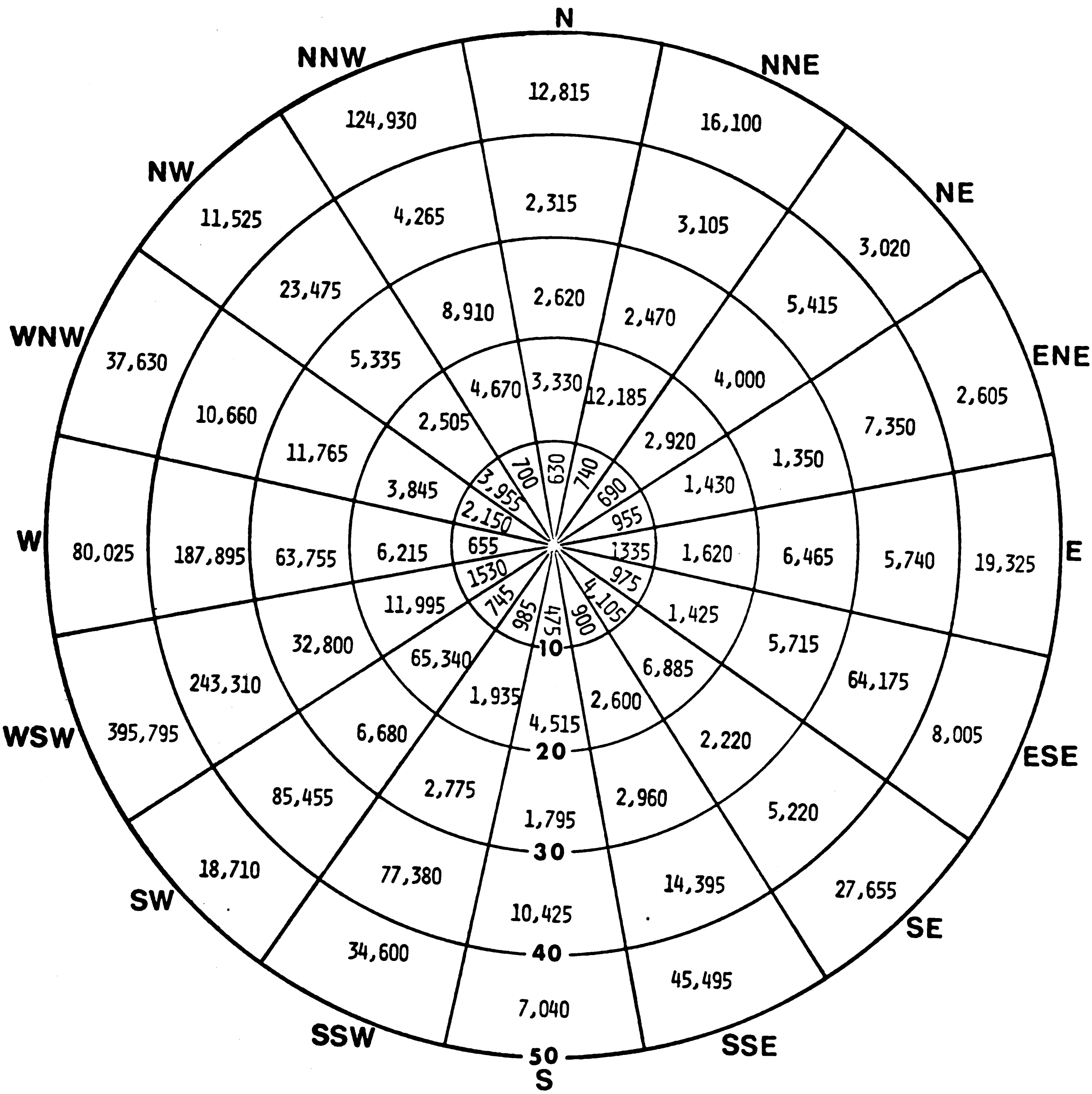


Figure 2-9

PROJECTED POPULATION DISTRIBUTION
WITHIN 50 MILES OF THE HARTSVILLE
PLANT FOR CENSUS YEAR 2020

Land Capability - Hartsville Site

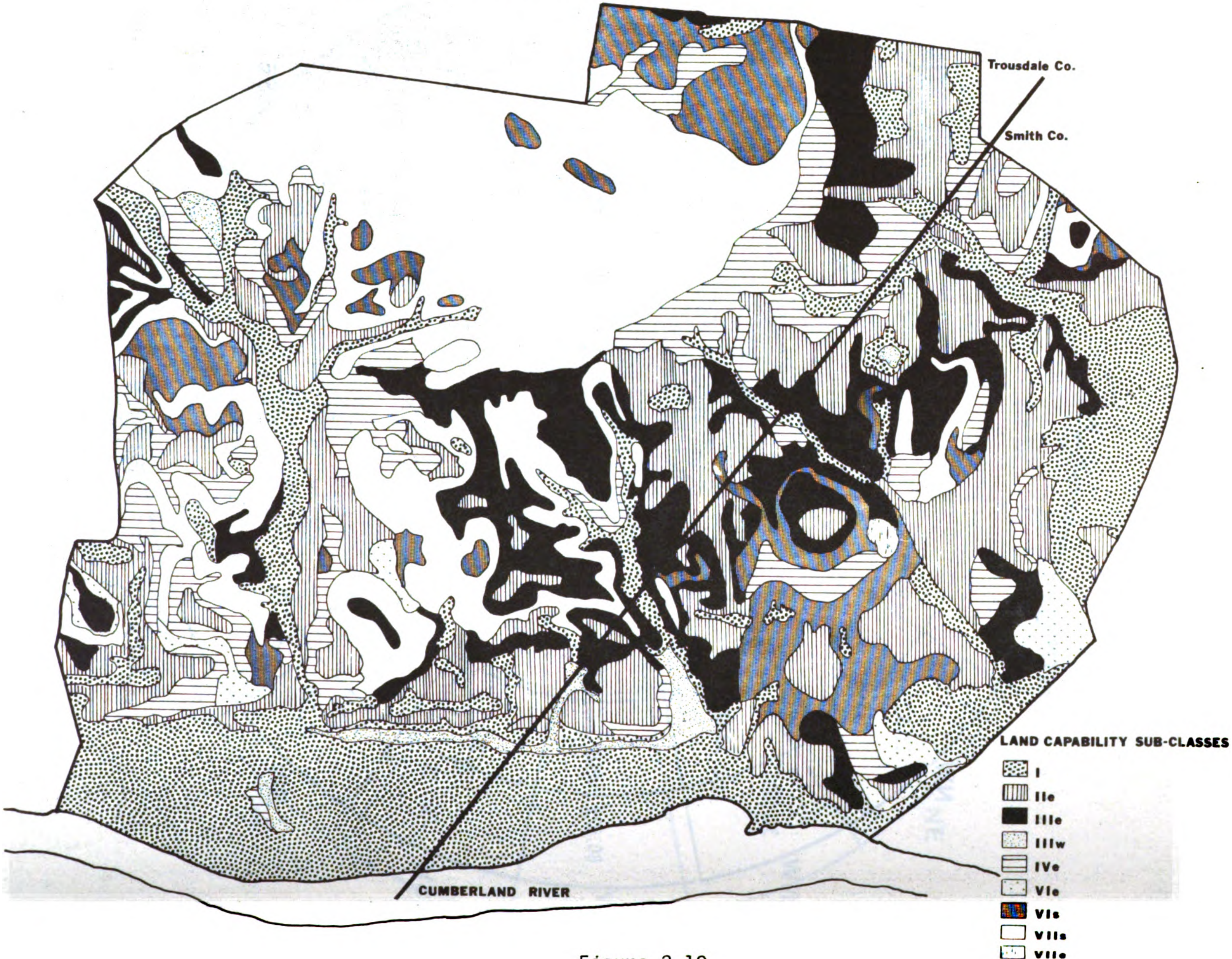


Figure 2-10

Figure 2-11

MCGEE HOUSE - NORTH VIEW

Figure 2-12
WRIGHT-OLDHAM HOUSE

Figure 2-13
TILMAN DIXON HOUSE

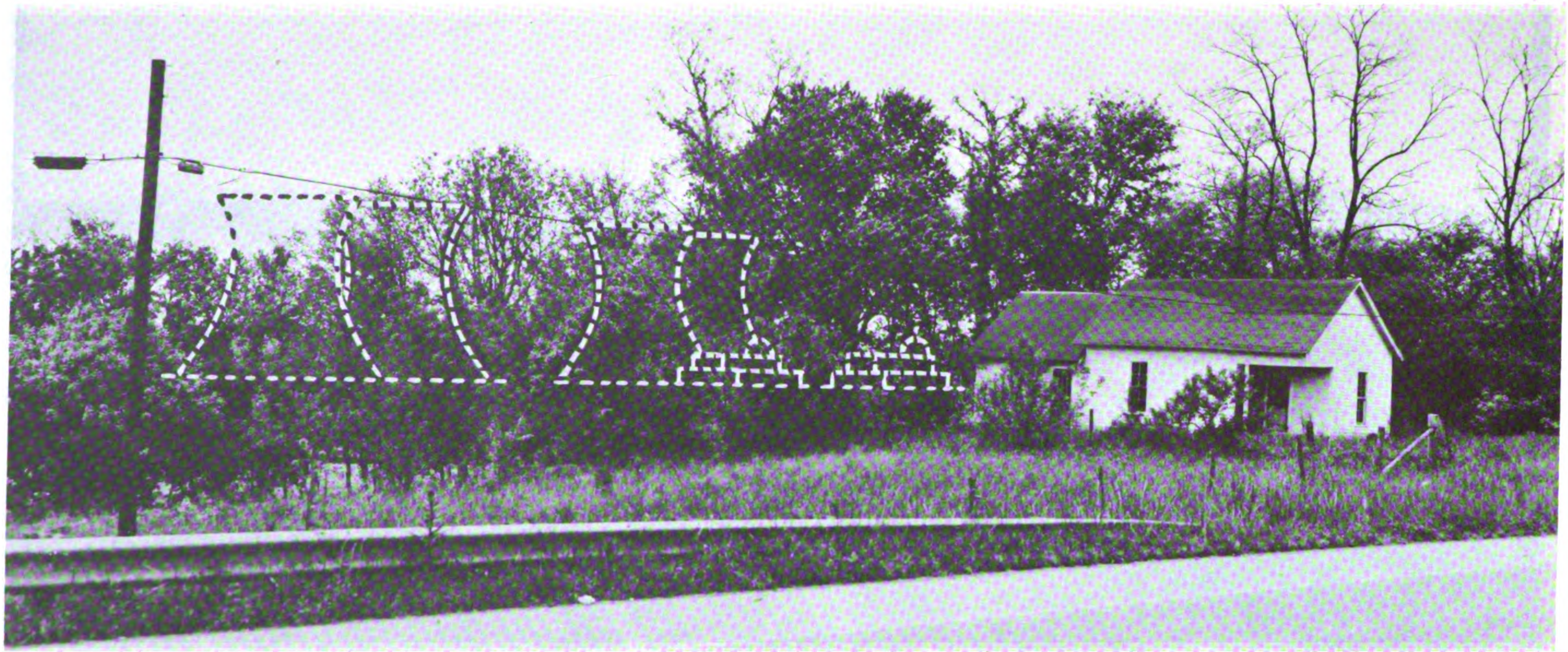
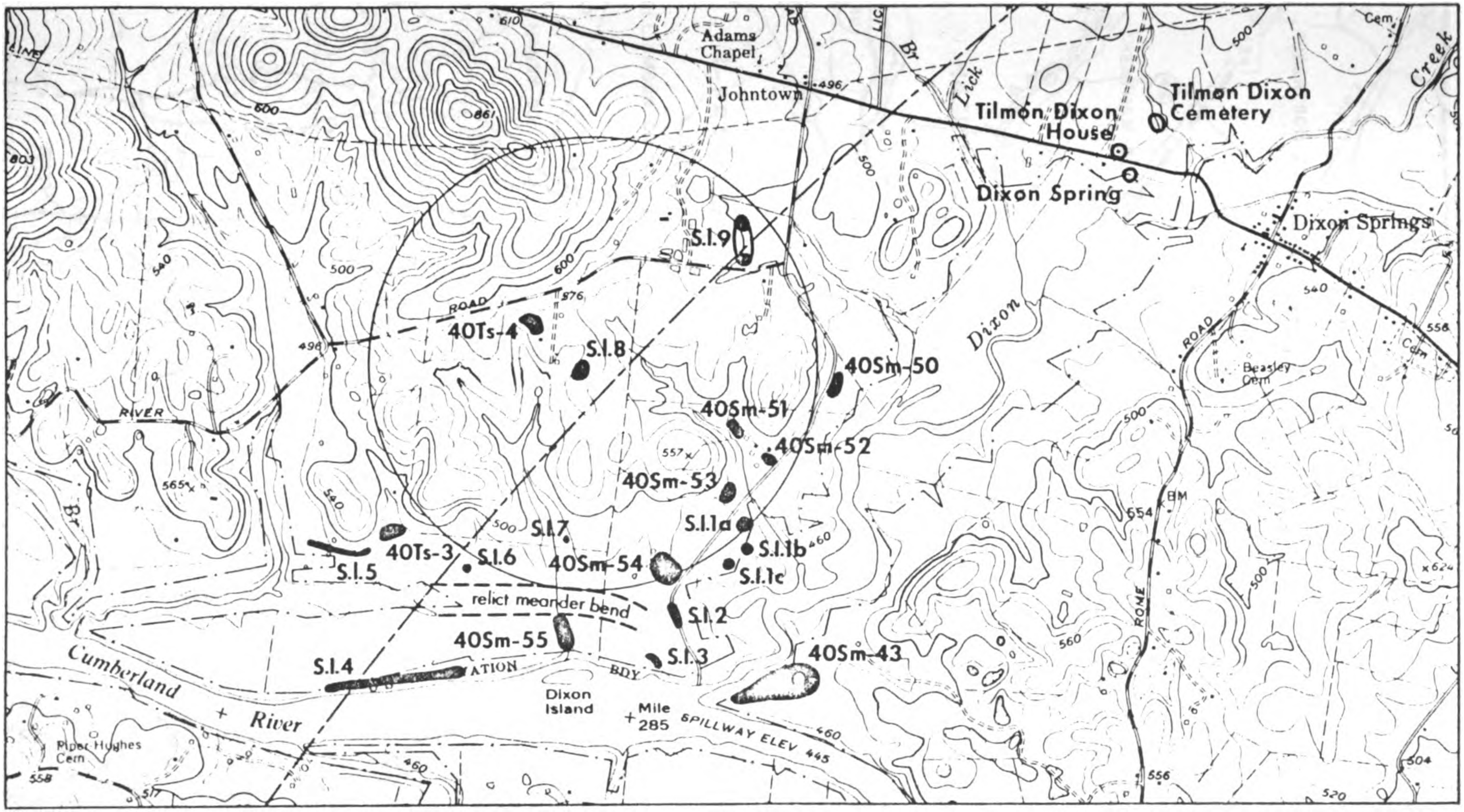


Figure 2-14

VIEW FROM DIXONA TOWARD PLANT

Figure 2-15

VIEW FROM DIXON SPRINGS



Archaeological Site or Surface Indication

Historic Feature

N

1000 0 1000 2000 Feet

SCALE

Topography taken from USGS 7.5 minute quadrangle, Dixon Springs, Tennessee
Contour interval is 20 feet.

Figure 2-16

HARTSVILLE SITE

TENNESSEE VALLEY AUTHORITY
Known Archaeological Resources
(August 1972 Survey)
Dr. M.C.R. McCollough

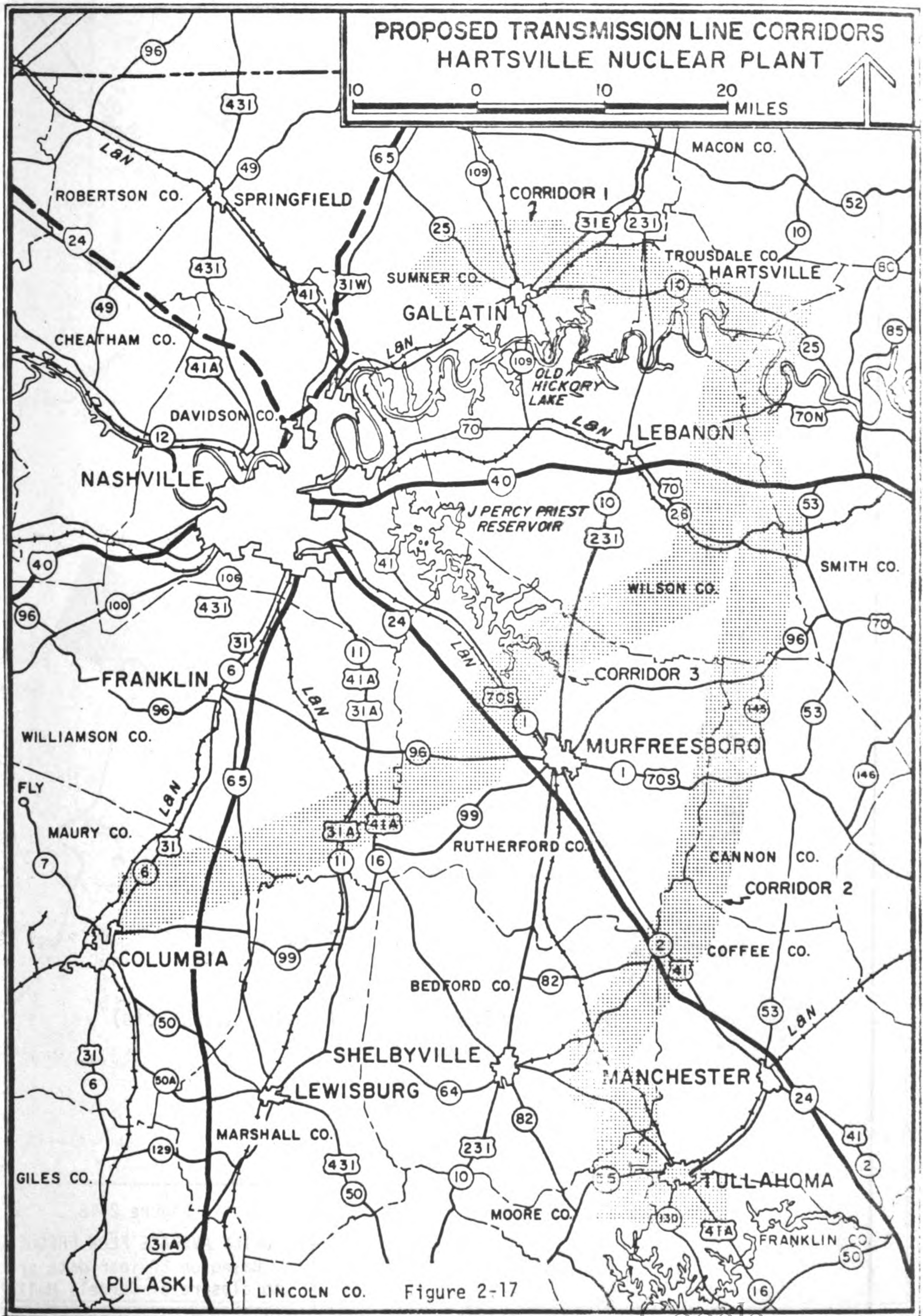

PROPOSED TRANSMISSION LINE CORRIDORS
HARTSVILLE NUCLEAR PLANT
10 0 10 20 MILES
CORRIDOR 1
CORRIDOR 2
CORRIDOR 3
ROBERTSON CO.
SPRINGFIELD
MACON CO.
SUMNER CO.
TROUSDALE CO.
HARTSVILLE
GALLATIN
CHEATHAM CO.
OLD HICKORY LAKE
DAVIDSON CO.
LEBANON
NASHVILLE
J PERCY PRIEST RESERVOIR
SMITH CO.
WILSON CO.
FRANKLIN
MURFREESBORO
WILLIAMSON CO.
FLY
MAURY CO.
RUTHERFORD CO.
CANNON CO.
COFFEE CO.
COLUMBIA
BEDFORD CO.
SHELBYVILLE
LEWISBURG
MANCHESTER
MARSHALL CO.
TULLAHOMA
GILES CO.
MOORE CO.
FRANKLIN CO.
PULASKI
LINCOLN CO.
L&N

Figure 2-17

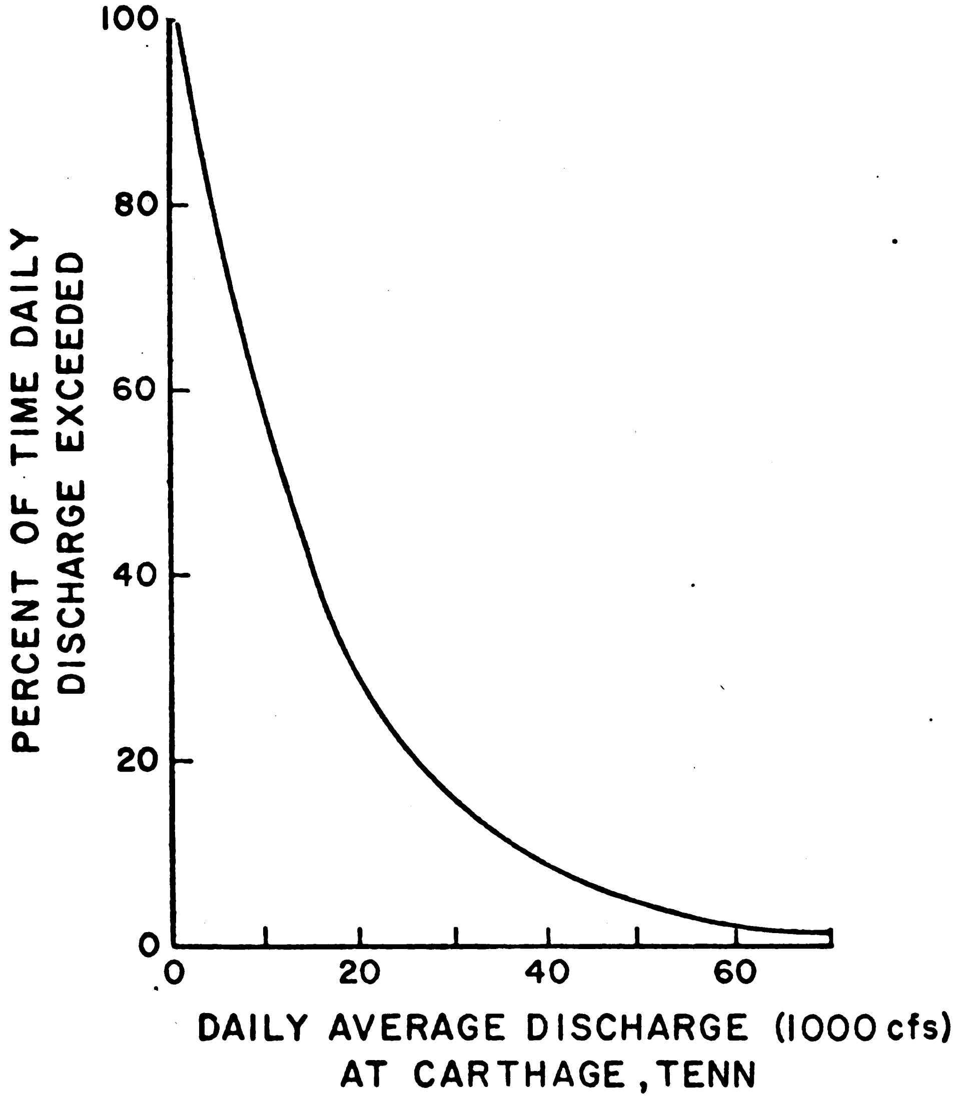
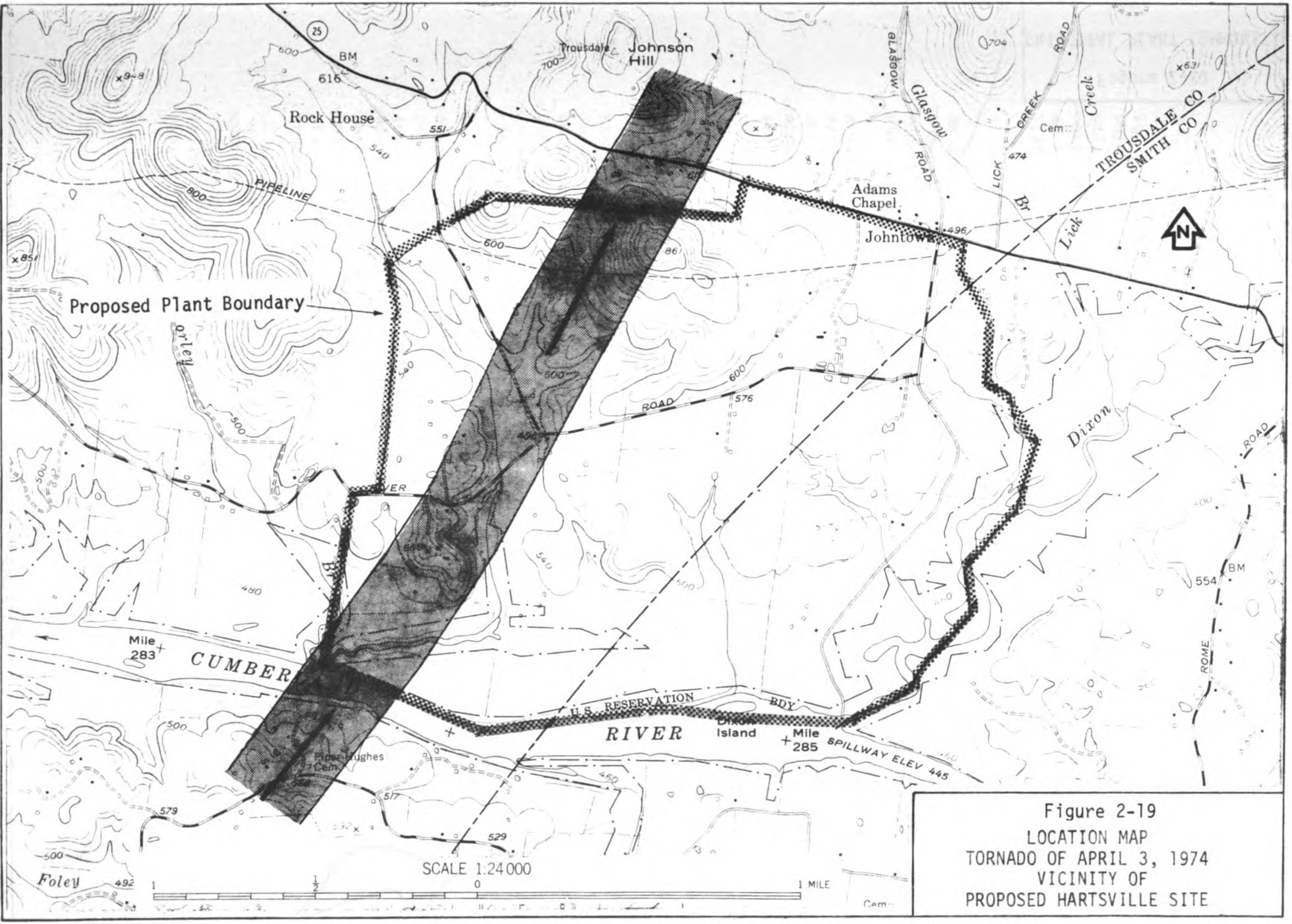


Figure 2-18

DAILY AVERAGE FLOW FREQUENCY
Based on 50 year data prior to closure of Cordell Hull Dam



Johnson Hill
Trousdale
Rock House
BM
616
551
540
PIPELINE
800
600
Proposed Plant Boundary
Adams Chapel
Johntown
496
GLASGOW
Glasgow
ROAD
LICK
CREEK
ROAD
Creek
Cem
474
Lick
Br
TROUSDALE CO
SMITH CO
Dixon
ROAD
576
500
480
540
Mile 283
CUMBER
RIVER
U.S. RESERVATION BDY
Dixon Island
Mile 285
SPILLWAY ELEV 445
460
554
BM
ROME
579
517
529
Foley
492
SCALE 1:24000
1
½
0
1 MILE

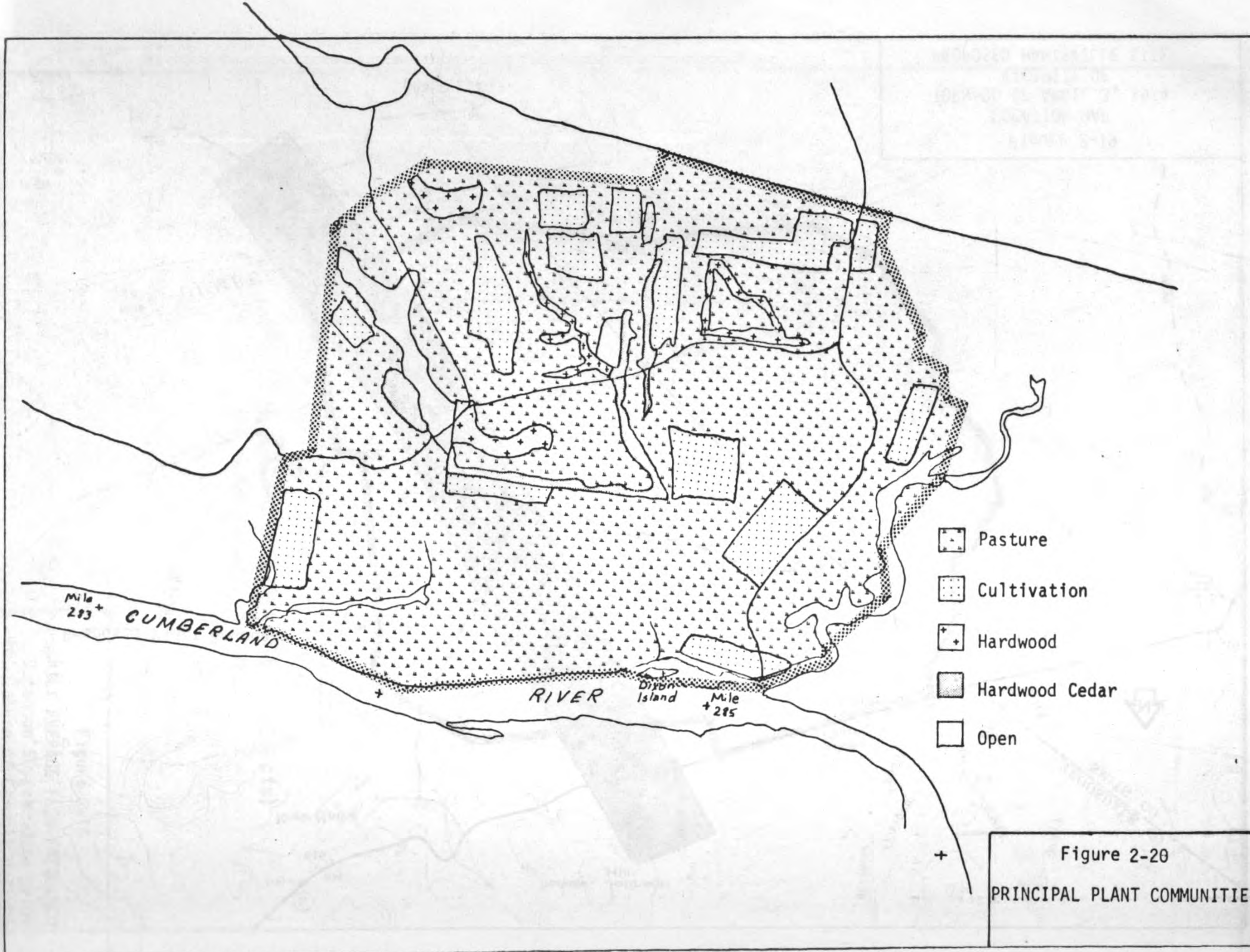


Figure 2-20

PRINCIPAL PLANT COMMUNITIES

3.1 Introduction

The Hartsville Nuclear Plants will consist of two identical plants which will each employ two identical boiling water reactors which will be supplied by the General Electric Company. Each reactor is rated at 3,579 MW core thermal power and each of the turbogenerators at 1,220 MW electrical power. Design power is 3,758 MW thermal and 1,285 MW electrical.

3.2 External Appearance

An artist's impression of an aerial view of the complex has been superimposed on an aerial photograph of the site area taken in a generally southerly direction in Figure 3-1. Figure 3-2 is a general plant layout.

A visitors center will be constructed on site. The center is not designed as yet, but the facilities could include such items as an overlook and parking area, a reception and display area, and an auditorium or theater. Based on visitation at existing TVA steam plants and projected visits to the visitor facilities planned for other TVA nuclear plants, as well as on the Hartsville site's location with respect to major highways, population centers, and other area visitor attractions, TVA estimates that the minimum average annual visitation which can be expected at the plant's visitors center facilities will be in the range of 65,000 to 75,000 visits per year.

3.2.1 Nuclear Steam Supply System - The reactors will be General Electric's BWR-6 units incorporating General Electric's Standard Reactor Island Design (STRIDE). STRIDE includes the design of the following buildings and all the systems therein: reactor building, fuel building, auxiliary building, control building, diesel generator buildings, and radwaste building. The reactor vessels are 238 inches in diameter and contain a core made up of 732 fuel assemblies and 177 control rods.

3.2.2 Fuel Description - Fuel for the reactor core will consist of slightly enriched (average initial fuel load enrichment 1.97 wt% U^{235}) uranium dioxide pellets sealed in Zircaloy-2 tubes. These tubes (or fuel rods) are assembled into individual fuel bundles. A fuel bundle contains 63 fuel rods and one water rod that are spaced and supported in a square (8 by 8) array by an upper and lower tie plate. A fuel assembly consists of a fuel bundle and the channel which surrounds it. Reactor core control will be achieved by 177 moveable, bottom entry, stainless steel control rods containing boron carbide (B_4C).

3.2.3 Steam and Power Conversion System - The steam and power conversion system for each of the four units is designed to produce electrical power from heat produced in the reactor. The waste heat is rejected to the atmosphere through the plant's condenser cooling water system.

The major components of the steam and power conversion system are turbine generator, main condenser, steam jet air ejectors, vacuum pumps (for initial evacuation of the main condenser), turbine seal system, turbine bypass system, hotwell pumps, condensate demineralizers, condensate booster pumps, reactor feed pumps, reactor feed pump turbines, reactor feed pump turbine condensers, feedwater heaters, heater drain pumps, and condensate storage system.

Main steam from the reactors is used to drive the high and low pressure main turbines. Main steam is also used for superheating, driving reactor feed pump turbines, generation of "clean" steam and other inplant uses.

3.3 Plant Water Use

Water use during normal full load operation for one plant is shown in Figure 3-3 and tabulated in Table 3-1. The total water use of both plants will be twice the amounts shown as the two plants are identical and will have approximately the same water use needs.

All water needs except possibly the potable water needs will be taken from the Cumberland River through a common intake for both plants. The potable water supply has not been located for the plants at this time.

Recycling or cascading of water will be done whenever or wherever it is technically and economically feasible within the limits of inplant water inventories in order to minimize plant water needs.

Waste water which cannot practicably be recycled or reused will be discharged through a diffuser and mixed with the Cumberland River.

Water which is consumptively used, that is, taken and used by the plant and not returned to the source, consists primarily of the water lost by evaporation from the condenser circulating water cooling towers and smaller losses from the essential service water spray ponds. Other small losses include water contained in waste sludges and partially dewatered wastes which are buried or disposed of otherwise, and wastes which are vaporized to the atmosphere.

3.4 Heat Dissipation System

3.4.1 Natural Draft Cooling Towers - During the operation of the Hartsville Nuclear Plants, cooling water will be required for operation of the condensers and other heat exchange equipment. TVA proposes to install four closed-cycle natural draft wet only hyperbolic cooling towers to meet cooling requirements and to reduce impacts to the environment. This type of condenser cooling water system will cycle cool water from the cooling towers through the condensers and discharge the warmed water back to the cooling towers rather than to the river (see figure 3-4). Each tower will be approximately 400 feet in diameter and 460 feet high and will be spaced about one tower-width apart.

Approximately 1,000 ft^3/s of cooling water from the cooling towers will circulate through the main condenser and raw cooling water system (RCW). The temperature will be raised by approximately 36° F. in removing 8.1×10^9 Btu/h from each unit. About 2.0×10^8 lbs/hr (2.9 billion ft^3/h) of air will be drawn through each tower. During the operation of the cooling towers a portion of the circulating water is lost by evaporation, small leaks, drift,[a] and blowdown.[b] Recent manufacturers' test results[1,2] show drift to be less than .01 percent (45 gal/min) of the circulating water flow rate. Evaporation is expected to average 50,000 gal/min (112 ft^3/s).[3] Blowdown will approximately equal the evaporation rate to maintain a cooling water to makeup water dissolved solids ratio of 2.

Total makeup water will average about 102,000 gal/min (228 ft^3/s). Therefore, total consumptive use of water (evaporation, drift, leaks) will average about 52,000 gal/min (112 ft^3/s). Blowdown temperatures to the reservoir will average as follows: winter, 65° F.; spring, 74° F.; summer, 84° F.; and fall, 74° F. Differences in reservoir and blowdown temperatures vary widely with the ambient temperature.

3.4.2 Intake System - One deepwater, mid-river intake will be used to serve both plants and will consist of an inland pump station, a 2,500-foot channel, a shoreline riprapped dike, and submerged pipes to connect the inland channel with the deepwater intake in the Cumberland River. Details of the system are shown in figure 3-5.

The deepwater intake will consist of six corrugated steel pipes through the dike to the center of the river (about 200 feet). The pipe inverts will be 20 feet below the surface (442 MSL) where the pipes will be supported by a bed of crushed rock and held in place by a concrete anchorage system.

The open channel from the dike will have a base width of 20 feet and will be cut out of both earth and rock (see figure 3-5). Approximately 296,600 cubic yards of earth and 31,600 cubic yards of rock will be excavated. The earth slopes will be grassed. Riprap (4,800 cubic yards) will be placed on the earth slopes from 2 feet below normal minimum pool level to 3 feet above normal maximum pool level. An additional 1,600 cubic yards of blanket material will be required. The intake velocity for the intake system, with the reservoir at the normal minimum pool level and with normal plant water requirements, ranges from 1.53 ft/s at the intake pipes to .15 ft/s at the pump station forebay.

The pump station will be located at the end of the 2,500 feet open channel to minimize the size of the structure and balance the cost of electrical and mechanical conduits against channel excavation, while

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a. Drift is fine water droplets entrained in the warm air flow and physically carried out of the tower.

b. Blowdown is water discharged from the system to the reservoir in order to control the total dissolved solids in the cooling water.

still avoiding other major site features (e.g., slopes from plant grade, discharge pond dike, etc.). The inland pump station will have eight intake openings, (four openings for each plant) with a maximum inlet flow velocity of 0.5 ft/s.

3.4.3 Discharge System - The blowdown water from the essential service water (ESW) and the condenser circulating water (CCW) systems is piped to a blowdown stilling structure to combine the blowdown from each plant and reduce water velocity. A paved ditch carries the water to a 30- to 35-acre pond. An underground pipe will carry the water from the pond to an anchored corrugated steel diffuser pipe extending perpendicular to the shoreline. A control valve on the underground pipe will maintain a relatively constant head, causing a discharge velocity of 10 to 15 ft/s to provide ample mixing from the diffuser.

The discharge pond has sufficient volume to contain 30 hours discharge above normal contents if accidental spills or reservoir conditions do not permit discharge from the pond. In addition, blowdown from the towers could be shut off for approximately 30 hours in order to meet applicable guidelines before plant operation would be jeopardized.

Therefore, discharges to the reservoir could be held up for about 60 hours if necessary.

Navigational clearance in the reservoir will be maintained at minimum reservoir level. A grass-lined overflow ditch will extend from the discharge pond to the river in the event that a blockage of the diffuser pipe occurs.

3.4.4 Essential Service Water System - The ESW system will provide cooling water to essential plant auxiliary equipment under normal and accident conditions. The system operates on a closed cycle with waste heat being dissipated via one spray pond for each unit. Each pond will occupy between 3.5 and 4.0 acres. The total makeup and blowdown requirements for the entire 4-unit plant will be approximately 2,000 and 1,000 gal/min respectively.

The spray ponds will serve as the ultimate heat sink for the facility. The spray ponds will be seismically qualified and will have adequate storage to maintain safe shutdown of the plant.

3.5 Radwaste System

Each 2-unit plant will be equipped with radwaste process equipment necessary to collect, treat, and dispose of radioactive solids, liquids, and gaseous waste produced during plant operations. System descriptions, process information, and effluent release data for the solid, liquid, and gaseous radwaste systems are presented in Sections 3.5.1 through 3.5.3 below. Discussion of source terms and calculational methods is found in Section 3.5.4 of the environmental report.

3.5.1 Liquid Radwaste System - The liquid radwaste system is designed to collect, process, recycle, and dispose of radioactive liquid wastes. The systems to be installed will limit releases to the environment to levels well below regulatory limits. This is accomplished by utilizing recycle of treated liquid waste for inplant service to the maximum extent practicable. There will be one complete liquid radwaste system per plant; that is, for a particular plant liquid radwaste will be received from each unit, but will be processed by equipment common to both units.

The liquid radwaste system consists of three subsystems: waste collector (low conductivity), floor drain - neutralizer (high conductivity), and detergent. A process flow diagram of the liquid radwaste system which shows the three subsystems is given in figure 3-6. Liquid radwaste system process information such as process frequency, gross radioactivity, conductivity, and system service data is given in Table 3-2. The process information in Table 3-2 is keyed to nodal numbers for the various components and operations depicted schematically in Figure 3-6. The flow and radioactivity data in Table 3-2 are on a per-unit basis. A listing of liquid radwaste process equipment is given in Table 3-3. System descriptions, including discussions of radioactivity released, for the Liquid Radwaste Subsystems are given below. Concentrations of radionuclides in the plant effluent prior to and after mixing in the Cumberland River are given in Table 5-1.

Waste Collector Subsystem - The waste collector subsystem processes liquid waste having a relatively high chemical purity. Typical wastes processed by this system are the equipment drains, the condensate demineralizer flushes, the resin cleaner backwashes and waste from filter demineralizer operation.

The wastes from each of these sources are collected and then processed on a batch basis. The wastes are filtered and then demineralized with the waste being solidified and packaged for disposal. Under normal operating conditions, all liquids are recycled. Both normal and maximum process frequencies, flow rates, and activities for the waste collector subsystem are given in Table 3-2.

Floor Drain Neutralizer Subsystem - The floor drain neutralizer is designed to collect and process both floor drain wastes and chemical solutions. Floor drain wastes are collected in sumps in the following locations.

1. Drywell
2. Containment building
3. Fuel building
4. Auxiliary building
5. Radwaste building
6. Turbine building

Chemical waste liquids such as decontaminants, condensate demineralizer spent regenerants, and chemical drains are also routed to the high-conductivity tanks. Floor drain neutralizer subsystem wastes are

processed by evaporators and polishing demineralizers and normally recycled. Evaporator bottoms are processed in the solid radwaste system. Under abnormal conditions, it may be necessary to discharge excess water to the environment in order to maintain the required plant-water balance. Water to be released to the environment is sampled in the excess water tank before discharge. The water may be discharged to the cooling tower blowdown system or processed through the detergent evaporator and discharged as a vapor. The liquid effluent released to the blowdown system is discharged to the Cumberland River via the plant discharge diffuser. With 4 units operating, a full blowdown flow of 50,000 gpm is available for dilution of the liquid radwastes from plants A and B. Liquid radwastes will not be discharged to the discharge pond but will be piped separately from the plants and interconnected with the discharge piping below the outlet of the discharge pond.

An annual release rate per nuclide per unit based on an assumed discharge of 15 percent of the floor drain neutralizer subsystem processed volume is given in Table 3-4. With this assumed discharge, the total annual discharge from the subsystem is approximately 0.02 curies per year per unit, which is well below regulatory limits.

Detergent Waste Subsystem - The detergent subsystem collects and treats laundry detergent wastes and laboratory washwater. These wastes are filtered and evaporated. The vapor is released to the environment along with the radwaste building ventilation air. Because release from this subsystem is a gaseous effluent, it is discussed in Section 3.5.2. Process information such as gross radioactivity, flow rate, and process frequencies for the inputs to the detergent system are given in Table 3-2.

3.5.2 Gaseous Radwaste System - Plant gaseous radwaste effluents are collected and processed in such a manner that their releases to the environment are as low as practicable. There are five distinct systems involving gaseous radwaste minimization and control. These systems are:

1. Condenser mechanical vacuum pump system
2. Condenser offgas system
3. Building ventilation systems
4. Separate steam-sealing system
5. Detergent waste system.

Condenser Mechanical Vacuum Pump System - During pressure drawdown, quantities of noncondensible gases which have accumulated during shutdown and startup are expelled via the mechanical vacuum pump. When the pressure is reduced to the proper level by the vacuum pump, operation of the steam jet air ejectors is commenced, and noncondensible gases are routed to the condenser offgas system for treatment. The estimated radioactivity released to the environment via the mechanical vacuum pump route is given in Table 3-5. These releases are based on operation of the condenser mechanical vacuum pumps 16 hours per year. Vacuum pump effluents are discharged to the environment through the turbine building vent.

Building Ventilation Systems - The building ventilation systems are designed to:

1. Provide cooling of process equipment
2. Provide ventilation and cooling necessary for personnel safety and comfort
3. Collect, process, and exhaust airborne radioactivity.

Routine releases of radioactivity from principal buildings will be kept as low as practicable. Gaseous radioactive wastes may be vented through the ventilation systems of the reactor building, the fuel and auxiliary building, the turbine building, and the radwaste building.

During normal operating conditions, gaseous releases from the reactor building are the dry-well purge, containment purge, and annulus exhaust. Expected annual routine release from the reactor building are given in Table 3-5. Under normal operating conditions, each of these exhausts is vented to the atmosphere through the reactor building vent. The releases from these sources are monitored during release periods. If significant radioactivity levels should be detected the exhaust from the systems will be directed to the standby gas treatment system for processing prior to release.

Sources which may contribute to airborne radioactivity in the turbine building are main steam leakage, water leakage from equipment, and gaseous releases from vents and drains. Radioactive gases are collected and disposed of by the turbine building ventilation system.

The turbine building ventilation system is designed to give one air change per hour. The system employs recycle of air from noncontaminated portions of the building.

Air supplied to the contaminated areas is not recycled. The exhaust system creates a negative pressure within the contaminated areas which induces air flow from cleaner areas to contaminated areas. Air from contaminated areas is collected in a system of ducts and is discharged to the atmosphere via the turbine building vent. Effluents released will be continuously monitored for radioactivity. Upon detection of high levels of activity, the building will be isolated. Expected annual routine releases from the turbine building with credit for sealing pressurized turbine building steam and flashing liquid valves 2-1/2" and larger are given in Table 3-5.

Airborne activity is released to the radwaste building atmosphere by equipment leakage and gaseous releases from vents and drains. These wastes are collected and discharged to the environment by the radwaste building ventilation system. The ventilation system will be the once-through type with air flow control from areas of low-potential radioactivity to higher activity areas. All building ventilation exhausts will be monitored for radioactivity prior to discharge. On detection of high levels of radiation, air flow will be interrupted and the building will be isolated. Expected yearly routine releases from the radwaste building are given in Table 3-5.

Separate Steam Sealing System - Two major sources of radioactivity release resulting from operation of the turbine cycle include: (1) exhausting of noncondensible gases originating from turbine gland sealing operations; and (2) steam leakage from turbine building pressurized steam and flashing liquid valves. The noncondensible gaseous effluents from turbine gland sealing operations are reduced by using clean steam generated by evaporating essentially nonradioactive condensate instead of extract (nuclear) steam for turbine gland sealing. The condensate has relatively low radioactivity levels since it has been degased in the condenser, delayed in the hotwell, and demineralized. Main steam leakage from valves to the turbine building atmosphere is reduced by collection and containing the actual leakage itself. However, the collection and containment must be done in such a manner that prevents air from leaking into the cycle. TVA proposes to accomplish this by equipping certain valves with multiple seals and supplying essentially nonradioactive steam as a sealant.

Condenser Offgas System - The condenser offgas system removes noncondensible gases from the main condenser. In addition to its power generation functions, the system serves two purposes, specifically, elimination of radiolytic gases (hydrogen and oxygen) and reduction of radioactive releases to the environment.

Noncondensible gases are removed from the condenser by the steam jet air ejectors and diluted with steam to ensure that the amount of hydrogen present is less than the combustible limit (4 percent by volume). The offgas is then routed to a catalytic recombiner where the hydrogen and oxygen are recombined. Following recombination, the moisture is removed and the gases are delayed in a holdup pipe. Then the gases are cooled to near 0° C, and introduced into charcoal adsorbers. There are 12 charcoal adsorbers (3 tons each) in the system. Eight beds will be in normal service with 4 in standby. The system will be capable of operating 12 beds during periods of high releases. The charcoal adsorbers are maintained in a refrigeration vault with an operating temperature of near 0° F. Essentially all radionuclides except the noble gases are removed by the charcoal beds (or decay away before leaving the beds). The holdup time of noble gases on the charcoal beds is dependent on the air leakage rate into the condenser. The gaseous effluents leaving the beds are passed through HEPA filters before reaching the environment. The gaseous effluents are released along with the turbine building ventilation exhaust. Expected annual average routine releases from this system are given in Table 3-5. These releases are based on a condenser air inleakage rate of 20 scfm.

Detergent Waste Subsystem - As previously described, detergent wastes are vaporized and discharged to the atmosphere as a gaseous effluent. The expected annual discharge of airborne effluents from the detergent subsystem of each reactor unit is given in Table 3-6.

3.5.3 Solid Radwaste System - The solid radwaste system is designed to collect, process, and package radioactive solid waste. Collection and processing will be done in such a manner as to restrict radioactive

releases to the plant and to the environment. Shielding will be provided as necessary during processing and shipping in order to meet regulatory requirements. Department of Transportation and AEC approved shipping containers will be used. Waste shipped from the site will be in solid form. No liquids or slurries are anticipated to be shipped from the site.

The solid radwaste system is located in the radwaste building of each plant. The system receives waste from both units. Waste processed by the system consists of evaporator concentrate, cleanup filter-demineralizer sludge, spent resins, traveling belt filter sludge and contaminated compressible and noncompressible material.

After dewatering and decaying as necessary the resin or filter-demineralizer sludges, the solids are dewatered by filtering and are placed directly in the shipping containers by screw conveyors.

Concentrated wastes resulting from the high conductivity and laundry subsystems are accumulated in the concentrated waste tanks and pumped directly to the shipping container.

The shipping containers are of steel construction with a volume of 170 ft^3. The filling and mixing operation is suitably instrumented to ensure that the proper proportions of wastes and cement are maintained, the container is not overfilled, and the appropriate radiation levels are not exceeded.

All slurry tanks and wet-solids handling equipment are separately shielded and are automatically operated from a remote position to reduce radiation exposure to operating personnel.

As with the liquid radwaste system, all solids processing equipment is shielded and remotely operated as required so as to minimize radiation exposure to operating personnel. Also, to minimize exposure, low maintenance of the solids handling equipment was an important design objective in selecting the system.

Dry solid wastes such as rags and clothing are low in radioactivity, permitting manual handling. These wastes are collected in containers near their source and moved to storage facilities in the solid waste handling area where they are compacted into 55-gallon drums with a hydraulic-press baling machine.

The expected nuclide distributions associated with each type of solid waste and the expected rate of shipment of these wastes (on a per unit basis) are given in Table 3-7.

3.6 Nonradioactive Chemical Wastes

General - It is TVA's policy to keep the discharge of all wastes from its facilities at the lowest practicable level by using the best and highest degree of waste treatment which is available with existing

technology and within reasonable economic limits. A flow diagram showing expected chemical discharges is depicted in Figure 3-7.

3.6.1 Condenser Cooling Water Systems - Effluents from the condenser cooling water systems will be discharged primarily by two modes. Approximately 112 ft^3/s of water from the four cooling towers would be blown down and discharged via the plant discharge diffuser during operation of the towers to maintain a cooling system solids concentration of about twice that of the reservoir solids concentration. In addition, approximately 0.40 ft^3/s of cooling tower water will be physically entrained in the air drawn through the towers and carried out of the towers. This effluent is called the "drift" from the towers.

Discharges from the CCW system will contain primarily only those compounds found in the river concentrated to approximately twice the concentration occurring in the river. The only chemical additives which will be added to the CCW system will be a small amount of biocides used to control flora and fauna growth.

Automatic mechanical cleaners will be used on the main condenser tubing, however, chlorine in the form of sodium hypochlorite will be fed to the CCW system to control biological growth in the system. The hypochlorite will be fed to achieve a chlorine residual of 0.5 ppm for one hour daily.

3.6.2 Raw Cooling Water Systems - In addition to the chlorine feed via the CCW system, additional treatment of the raw cooling water system with a biocide such as acrolein may be required to control fouling due to Corbicula manilensis, the Asiatic clam. If acrolein were used for this purpose, it would be fed to achieve an inlet concentration of 0.3 mg/l for 30 minutes daily during the 120 days in the spring and fall when the verliger larvae are in the water. It is anticipated that the blowdown from these systems would be closed during any biocide treatment periods to assure maximum protection of the reservoir.

3.6.3 Essential Service Water Systems - Effluents from the essential service water systems (ESW) will be similar to those from the CCW systems. During normal operation approximately 2.2 ft^3/s will be blown down from the ESW systems and discharged via the plant discharge diffuser to maintain the solids concentration in the systems at approximately twice that occurring in the reservoir. As discussed for the CCW, the blowdown from the systems will consist primarily of those elements brought in with the makeup from the reservoir. "Additives" to the ESW system will include only biocides such as chlorine and possibly acrolein. These would be used as discussed for the CCW system.

3.6.4 Filtered Water Treatment System - Raw water taken from the reservoir is treated to remove the suspended solids thus producing "filtered water" suitable for use as bearing lubricants and feed to the steam systems makeup demineralizer. The treatment plant will have a maximum capacity of 486 gallons per minute but will operate at this rate only before unit startup and during periods of unit outages which will

include a period of about 12 weeks annually. Normal operation will be about 120 gallons per minute for 8 hours per day.

Normal treatment of the raw water will require the use of such chemicals as aluminum sulfate, soda ash, and chlorine. This treatment will tend to make the suspended solids coagulate forming large heavy particles which settle out of the water. This floc will contain aluminum hydroxide and suspended solids. As the concentration of these solids builds up in the bottom of the settling basin, the concentrated slurry will be pumped to a solids separation unit. The system tentatively proposed for this purpose is a tubular filter unit where the slurry would be pumped through the filters which remove the floc and settled solids from the slurry. The solids material would then be hydraulically compressed to pack the sludge under high pressure. This compaction would result in a "cake" containing about 60 percent by weight floc and solids. The remaining 40 percent would be entrained moisture. The cake would be a solid residue suitable for disposal in an approved sanitary landfill. The filtrate would be recycled to the inlet of the water treatment plant and added to the raw makeup water for processing.

In addition to the treatment chemicals mentioned above, it may become advantageous to use a coagulation aid to improve the performance and efficiency of the filter plant. Any aid used would be selected from those approved for use by the Environmental Protection Agency and will be used in accordance with manufacturer's recommendations. Since a coagulation aid is used to improve the efficiency of the sedimentation process, its use should result in the use of less alum and soda ash.

Operation of each filter plant is expected to require the annual use of 57,526 pounds of aluminum sulfate ($Al_2(SO_4)_3$) and 20,712 pounds of soda ash (Na_2CO_3). The waste produced from the operation should amount to 26,000 pounds of aluminum hydroxide and 83,522 pounds of settled solids. Approximately 4,700,000 pounds of water will be recycled back into the makeup stream.

As a result of this process, approximately 1,070 cubic feet of processed solid waste will be generated annually from this source. This waste will be buried either onsite or offsite in an approved landfill, observing the applicable standards.

3.6.5 Makeup Demineralizer - Filtered water will be treated by a demineralization system to supply high-purity makeup water to the steam cycle and provide high-purity water for other minor plant uses such as equipment decontamination, laboratory use, etc. The demineralizers at each plant will have a capacity of 385 gallons per minute and can run for 20 hours per day while allowing 4 hours per day for required regeneration. It is anticipated that the system would run at full capacity only before unit startup and then during annual outages. These outages are expected for approximately 12 weeks per year. For the other 40 weeks per year, very little makeup is expected to be required because as much water as practical will be recycled from the waste systems. Based on this expected operational schedule, approximately

126,200 pounds of sulfuric acid and 103,000 pounds of sodium hydroxide will be used at each plant to regenerate the demineralizers. In addition, waste water will be generated because of the backwashing and rinsing requirements in the regeneration process. Approximately, 17,000 gallons of waste will be generated each time the demineralizer is regenerated.

The total volume of regenerant wastes generated per plant is expected to amount to 2,990,000 gallons per year.

This waste water and the spent regenerants are directed through a weak cation-anion exchanger, which will neutralize the wastes and discharge them to a sump where they are mixed together before being discharged to the CCW system. The sump will be monitored to assure that the acid and caustic have been effectively neutralized prior to discharge.

With the exception of the sulfuric acid and sodium hydroxide used to regenerate the demineralizers, the other constituents present are only "natural" elements which were removed from the treated raw water and not "added" compounds.

Maximum daily discharges and average annual expected discharges are shown in Table 3-8. Also included are the maximum concentrations expected in the cooling water blowdown discharge conduit and the maximum expected concentrations at the edge of the mixing zone in the river. Actual concentrations in the reservoir after further mixing will be even smaller than those shown.

3.6.6 Auxiliary Steam Generator System - Two 100,000 pound-per-hour oil-fired steam generators will be supplied per plant at the proposed Hartsville plant to provide steam for unit startup sealing and heating requirements, building heating requirements, and other minor plant steam needs.

Chemical treatment of the feedwater to these units will consist of the intermittent addition of ammonia for pH control and the continuous addition of hydrazine for scavenging dissolved oxygen in the system. The concentration of hydrazine in the feedwater will be about 10-15 ug/l, and the concentration within the system is expected to be below detectable levels. Blowdown from the generators will be utilized as the method for controlling the buildup of solids in the system and maintaining required water chemistry. Blowdown rates are expected to vary from 5,000 to 11,000 gallons per day for each pair of generators. It is expected that this blowdown will contain a concentration of about 0.3 mg/l of ammonia. This will result in an annual discharge from the generators of about 33 pounds of ammonia per plant.

The blowdown from the auxiliary steam generators will be discharged to the CCW system. It is expected that any residual ammonia will be scrubbed out by the CCW cooling towers such that there should be no detectable concentration of ammonia present in the CCW system blowdown.

3.6.7 Transformers and Electrical Facilities - Some oil leakage may occur from bearings and other parts of certain machinery inside buildings. The oil will be drained to an oil sump that will have adequate capacity to contain all spillage which will be recovered for reclaimation or disposal.

In the event of an outside oil spill from the main stepup transformer or insulating oil storage tank, the oil spillage will be routed to the storm drains and then to the drainage pond. At the drainage pond, the oil will be recovered for reclaimation or disposal.

Diesel fuel oil for auxiliary boilers and lube oil will be stored in tanks in an area which will be diked to form a basin of sufficient capacity to retain 1.5 times the contents of the largest storage tank. During periods of rainfall, some runoff water may accumulate in the basin. A valved low-level discharge pipe will be provided for periodic removal of precipitation collected within this area and basin contents will be inspected before discharge to assure that oil will not be released by this mechanism. The valve will be maintained in a closed position at all other times to provide for retention of oil should the tanks rupture.

In the interest of fire prevention, indoor transformer installations will be either Askarel-filled or dry-type transformers. When the former is used, the transformer will be located within a concrete basin to contain any possible spillage of this liquid. This will isolate this liquid (which contains polychlorinated biphenyls) from the common floor drainage system. Either a separate drain will be provided for routing any spillage to a separate storage sump or else the basin will be made high enough to hold the entire liquid content of the transformer. In either case, spilled liquid will subsequently be drummed for proper disposal if not suitable for reuse. Plans are to return the liquid to the manufacturer for ultimate disposal.

3.6.8 Auxiliary Systems - Various auxiliary reactor systems receive chemical treatment for corrosion control and other reasons. These systems are normally not used regularly in operations and are not sources of chemical discharges.

The standby liquid control system contains approximately a 12 percent concentration of sodium pentaborate used for reactor shutdown in emergency conditions. This system normally would only be used for periodic testing. Wastes from this system would be collected in drums for disposal as nonradioactive waste. The drums will be held onsite for disposal by an environmentally suitable method.

The residual heat removal system is placed in layup using ammonia and hydrazine for pH control and dissolved oxygen scavenging to control corrosion. This system is normally drained and flushed prior to unit shutdown and refilled with reactor grade water. The drains and flushes containing the ammonia and hydrazine are pumped to radwaste for treatment in the liquid radwaste system.

The closed cooling water system, used to cool the components of the reactor system during reactor shutdown, forms an intermediate barrier between the radioactive cooling system and the raw service system. As currently planned, the closed cooling water system will utilize water of sufficiently high quality that inhibitors will not be necessary. Should it become necessary to use an inhibitor, an amine such as ammonia would likely be used. If ammonia were used, the concentration within the component cooling water system is expected to be equivalent to about 5 ppm ammonia. Hydrazine or a similar agent could be used as an oxygen scavenger. The concentration of hydrazine in the system would likely be about 5-10 ppm.

When necessary for maintenance purposes, the cooling water will be drained from portions of the system. If possible, the water will be returned to the closed cooling water system. Otherwise, the water will be processed through the radwaste system for recycle or discharge.

3.6.9 Sanitary Waste Treatment System - The proposed systems would consist of a comminutor, a package extended aeration sewage treatment plant, and a 2,500-gallon chlorine contact tank per plant. A schematic diagram of the system is shown in figure 3-8.

Effluent from the process would be collected, chlorinated, and released through the diffuser pipe.

Waste sludge will be disposed of in a manner which meets applicable regulations. The design will be in accordance with approved sanitation standards applicable to TVA facilities and the waste treatment requirements of the Tennessee Pollution Control Board.

The treatment facility will be designed to handle the sewage load for approximately 350 persons (12,000 GPD) per plant which should be satisfactory for the permanent employees, temporary employees, and visitors at each plant. During periods when a large temporary maintenance force is working at the plant, the permanent waste treatment system will be supplemented by portable-type chemical toilets.

3.6.10 Chemical Drains - Some decontamination operations will involve the use of chemicals such as sodium phosphate, sodium permanganate, ammonium citrate, alkaline potassium permanganate, and nitric, citric, oxalic, acetic, and hydrofluoric acids. These wastes drain to the floor drain neutralizer tank in the radwaste system. The amounts of such chemicals have not been determined at this time.

The principal chemical reagents used in the laboratory will include sodium and ammonium hydroxides; hydrochloric, nitric, and sulfuric acids; ammonium acetate; and sodium carbonate. In addition, small quantities of various other chemicals will be used for analytical testing.

Contents of the floor drain neutralizer tank will be processed through the radwaste system as described in Section 3.5 and will not be routinely released.

<u>3.6.11 Detergent Waste System</u> - Detergent wastes from the laundry, laboratory washings, and equipment decontamination and cleaning will be collected in the waste detergent tanks in the radwaste system. Most equipment cleaning and decontamination operations will be performed with high-pressure water and with detergent solutions. The lowest practicable amount of detergent will also be used for laundry and similar uses. These wastes will be filtered and sent to the detergent evaporator. Distillate from the evaporator will be discharged to the atmosphere as a vapor and the bottoms will be drummed for disposal as solid radwaste. A more detailed discussion is contained in Section 3.5.

<u>3.6.12 Normal Solid Waste</u> - The nonradioactive solid waste generated at the Hartsville Nuclear Plant including sludge from the water treatment filter plant and the demineralizers, will be disposed of in a sanitary landfill located on TVA land and operated by TVA in accordance with EPA guidelines or in a state-approved sanitary landfill on non-TVA land and operated by a municipality, county, or private contractor.

It is estimated that the quantity of nonradioactive solid waste will be about 30 cubic yards per week plus an estimated 60 cubic yards of sludge per year.

The scrap metals (other than cans) will be salvaged and sold. Scrap lumber will be salvaged for reuse and made available to scavengers when it can no longer be used by TVA.

<u>3.6.13 Gaseous Emissions</u> - The oil-fired auxiliary steam generators will be used to supply steam for startup, building heating, and other minor plant uses.

The generators will be fired using No. 2 fuel oil having a maximum sulfur content of 0.5 percent. At maximum capacity, it is expected that they will require approximately 1,815 gallons per hour of fuel per plant.

Based on continuous full load operation the expected emissions of pollutants from the auxiliary steam generators at each plant are as follows:

Particulates	14.52 lb/h
Sulfur Oxides	142.58 lb/h
Carbon Monoxide	0.073 lb/h
Hydrocarbons	3.68 lb/h
Nitrogen Oxides	843.72 ton/yr

These emissions will be released through a stack at each plant, the top of which is approximately 40 feet above plant grade. The stacks for the two plants are approximately 2,050 feet apart.

Calculated maximum ambient pollutant concentrations resulting from the above emissions, together with the applicable ambient standards, are listed below for one plant.

Pollutant	Averaging Time	Calculated Concentration	Secondary Ambient Standards
Particulates	24-hour	0.68 $\mu g/m^3$	150 $\mu g/m^3$
Sulfur Oxides	24-hour	$2.60x10^{-3}$ppm	0.50 ppm
Carbon Monoxide	1-hour	$1.52x10^{-5}$ppm	35.0 ppm
Hydrocarbons	3-hour	$8.61x10^{-4}$ppm	0.24 ppm
Nitrogen Oxides	1-year	$2.25x10^{-4}$ppm	0.05 ppm

3.6.14 Storage Tanks - The plants will be designed so that leakage, spillage, or container ruptures from any cause will not flow directly to the reservoir. Accidental releases of these liquids will either be contained in the immediate vicinity of the storage container until recovery or be routed to the yard drainage holding pond for recovery or treatment.

3.6.15 Yard Drainage Systems - Areas will be diked off to provide two yard drainage ponds of approximately 15 acres each. The ponds will contain a volume of approximately 200 acre-feet each.

The building roof drainage system drains into the storm drainage system and thence to the yard drainage pond. The ponds will be equipped with an overflow weir with a skimmer structure which will discharge into Dixon Creek and the unnamed creek on the western portion of the site.

Any debris or oil which may be spilled in the yard will enter the yard drainage system and will flow to this pond and be contained. The solid material will be removed as necessary from the pond and disposed of in accordance with guidelines established for the disposal of solid waste. Oil will be reclaimed for reuse when practicable. If not suitable for reuse, it will be drummed and held onsite for disposal by an environmentally suitable method.

Various sumps which will not contain any hazardous or radioactive material also discharge to the yard drainage pond. These sumps would not normally handle any substances potentially detrimental to the environment. They may occasionally contain some oil which has leaked from some indoor machinery. Oil reaching the holding pool via this route will be reclaimed for disposal as described above.

3.7 Transmission Facilities

The route corridors for the transmission line connection to the proposed Hartsville Nuclear Plant are shown as dashed lines on figure 3-9. Approximately 5,400 acres of land will be encumbered by these corridors, of which 40 percent is forested, 58 percent is nonforest and 2 percent is water.

To minimize total land requirements, four sections of the proposed 500-kv line connections will be designed to accommodate 161-kv underbuilt lines. Right of way corridors will vary from 175 to 425 feet wide.

3.7.1 General Description - line design - The proposed 500-kV transmission lines will be designed to use single circuit self-supporting steel towers of a four-legged configuration using body extensions and variable length legs to fit local ground conditions. This structure (figure 3-10) has a basic height to the crossarm of 84 feet, but variations will be made to provide ground clearance as necessary to meet or exceed requirements of the National Electric Safety Code (Sixth Edition). Subconductor and phase separation, lightning protection and insulators are designed to maximize safety.

The 161-kV underbuilt transmission lines will provide the station service emergency shutdown power to the proposed nuclear plant. The resulting double-circuit tower configuration (figure 3-11) will extend from the approximate location of the Hartsville Nuclear Plant site to an intersection with (1) the Gallatin-Lafayette 161-kV line, located approximately 1 mile northeast of Paynes Store, and (2) the Gallatin-Cordell Hull 161-kV line, located approximately 5.5 miles south of the plant site.

3.7.2 Transmission Line Corridor Descriptions - The land of middle Tennessee where the corridors will be located is level to rolling (between 600-1,200 feet elevation). The soils are generally moderate to low in fertility in the eastern areas. About one-third of the area is in forest, mainly farm woodlands with large commercial holdings on steeper lands. Outer basin topography is gentle and soils are often deep and fertile. Inner basin sites slope less and are less fertile and drier.

There are 1,888,800 acres of forest in the 12 middle Tennessee counties (Cannon, Smith, Sumner, Trousdale, Wilson, Williamson, Rutherford, Maury, Franklin, Moore, Bedford and Coffee) that the corridors traverse. The forested area involved is mostly small farm woodlands and areas along water courses where steep slopes prevent other land uses.

Approximately 50 percent of the rights of way fall in counties where TVA does not conduct permanent forest inventories. TVA aerial photos and visual reconnaissance were used to estimate the timber resources for this portion.

The present volume of all merchantable sawtimber trees (Table 3-9) on the 2,311 acres is estimated to be 4,848,400 bd. ft. (2,098 bd. ft. per acre).

Productivity is estimated at 45 ft^3 of wood per acre per year or 103,995 ft^3 annually for the 2,311 forested acres. This is .19 percent of the annual productivity of the 12-county area traversed by the rights of way.

3.7.2.1 Corridor 1 - The future Wilson-Montgomery 500-kV Transmission Line corridor will be opened approximately 6 miles west of Gallatin, Tennessee, and looped to the Hartsville Nuclear Plant. This will form the Wilson-Hartsville 500-kV Transmission Line and the Montgomery-Hartsville 500-kV Transmission Line.

This proposed loop connection will be constructed using single circuit, self-supporting steel towers (Figure 3-10) except for approximately 9 miles which will be underbuilt with 161-kV circuits. The tower configuration to be utilized in the underbuilt section of line is shown on Figure 3-11. Corridor 1 will utilize right of way 300 feet wide; 275 feet of which will be cleared.

3.7.2.2 Corridor 2 - This proposed transmission line corridor will be approximately 86 miles in length and will vary in width from 175 feet to 325 feet. A 68-mile section of 175-foot-wide right of way will be occupied by one 500-kV transmission line except for a 6-mile section adjacent to the Hartsville Nuclear Plant which will be underbuilt with a 161-kV transmission line. Approximately 12 miles of 200-foot-wide right of way east of Shelbyville which was purchased for the Maury-Franklin 500-kV Transmission Line project will also be utilized for the Hartsville-Franklin 500-kV line connection. An additional 100 feet of right of way will be required to accommodate these two circuits. A 9-mile section of 325-foot right of way in the vicinity of Tullahoma is existing right of way for a 161-kV transmission line and was purchased in anticipation of future 500-kV connections into the Franklin 500-kV Substation.

The corridor terminates within the Arnold Engineering Development Center and Tennessee Wildlife Resources Agency Wildlife Management area. The line construction and revegetation plans for the portion of the corridor within the management area will be reviewed with both parties. Construction activities will be planned to minimize potential impacts as much as possible.

3.7.2.3 Corridor 3 - This proposed transmission line corridor will be approximately 78 miles in length and will vary in width from 175 feet to 425 feet. A total of three 500-kV connections and one 161-kV connection will utilize portions of the corridor.

The existing Bull Run-Wilson 500-kV Transmission Line which is located about 16 miles south of the proposed nuclear plant will be opened, and two sections of line, each approximately 16 miles in length, will be constructed to the Hartsville Nuclear Plant switchyard. This will provide electrical connections from Hartsville to both Wilson and Bull Run 500-kV Substations. The third 500-kV connection will be provided by constructing a new line from the nuclear plant to the Maury 500-kV Substation.

The existing Gallatin-Cordell Hull 161-kV Transmission Line which is also located south of the nuclear plant will be connected into

the plant switchyard. This 6-mile circuit will be constructed as an underbuilt circuit common with one of the 500-kV lines along corridor 3.

The last 31 miles of corridor 3 will utilize existing right of way 75 feet wide. To accommodate the proposed 500-kV connection, an additional 100 feet of right of way will be acquired for this section.

3.7.3 Construction Power Facilities - To provide electrical power for construction of the Hartsville Nuclear Plant, a temporary 7.8-mile section of line will be constructed from the Gallatin-Hartsville 69-kV Transmission Line to the Hartsville Construction Substation. The proposed route and substation location are shown on Figure 3-12. The line will be designed for 69-kV operation, single-circuit, wood pole construction, with post type insulators and will require 50 feet of new easement. To minimize environmental impacts, 5.1 miles of the line will parallel an existing gas pipeline right of way. The TVA right of way will overlap the 50-foot-wide pipeline right of way by 23 feet, but the transmission line structures will be constructed a minimum of two feet outside the existing pipeline right of way. This will result in a total easement width of 77 feet for this 5.1-mile section. Of the remaining 2.7 miles, 1.6 miles will be on TVA property within the boundary of the Hartsville Nuclear Plant, and 1.1 miles will be constructed on right of way 50 feet wide which will be obtained by TVA.

REFERENCES FOR CHAPTER 3

1. "Cooling Tower Drift - Its Measurement, Control and Environmental Effects": G. K. Winstrom and J. C. Ovard, paper presented at Cooling Tower Institute Annual Meeting, January 29-31, 1973

2. "Drift Technology for Cooling Towers", J. D. Homberg and O. L. Kinney, report published by the Marley Company, 1973.

3. "Managing Waste Heat with the Water Cooling Tower", J. B. Dickey, Jr., and R. E. Cates, report published by the Marley Company, 1973.

Table 3-1

Water Use

Normal Full Load Operation

		GPM (per 2-unit plant)
1.	Screen wash	240 (when used)
2.	Fire protection	0
3.	Condenser cooling water makeup	50,000
4.	Essential service water makeup	1,000
5.	Condenser cooling water	900,000
6.	Cooling tower evaporation	25,000
7.	Cooling tower drift	90
8.	Raw cooling water	36,000
9.	Condenser cooling water blowdown	25,000
10.	Essential service water	28,000
11.	Essential service water blowdown	500
12.	Essential service water evaporation	500
13.	Service water	Dependent on System Requirements 1,720 GPM Maximum
14.	Makeup treatment plant	120
15.	Drains to station sump	600
16.	Roof drains	Dependent on Rainfall
17.	Yard drains	Dependent on Rainfall
18.	Potable water	8
19.	Sanitary waste	8
20.	Liquid radwaste	31
21.	Package radwaste	4
22.	Recycle to condensate storage	27
23.	Discharge diffuser	25,500

Table 3-1 (Continued)

Water Use

Accident or Emergency Conditions

		GPM (per 2-unit plant)
1.	Screen Wash	240 (when used)
2.	Fire protection	8,000 maximum
3.	Condenser cooling water makeup	--
4.	Essential service water makeup	1,000
5.	Condenser cooling water	--
6.	Cooling tower evaporation	--
7.	Cooling tower drift	--
8.	Raw service water	--
9.	Condenser cooling water blowdown	--
10.	Essential service cooling water	57,200
11.	Essential service water blowdown	500
12.	Essential service water evaporation	500
13.	Service water	Dependent on System Requirements 1,720 maximum
14.	Makeup treatment plant	--
15.	Drains to station sump	600
16.	Roof drains	Dependent on Rainfall
17.	Yard drains	Dependent on Rainfall
18.	Potable water	8
19.	Sanitary waste	8
20.	Liquid radwaste	160
21.	Package radwaste	60
22.	Recycle to condensate storage	100
23.	Discharge diffuser	--

Table 3-2

LIQUID RADWASTE PROCESS INFORMATION (PER UNIT BASIS)

[illegible]

STREAM NO. △	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
NORMAL BATCH/DAY	0.8/1	0.1/1	1.1/1	0.8/1	1/80	1/58		1/1	13/80	1/1	6/1	6/1	6/1	—	13/80	—	1.0/1	2.2/1	1.1/1	2.2/1	1/1	—
MAXIMUM BATCH/DAY	60/1	10/1	1.1/1	0.8/1	1/60	1/1		4/1	4/1	8/1	10/1	10/1	10/1	—	4/1	—	60/1	17/1	1.1/1	2.2/1	—	—
NOR DAILY VOL, GAL./DAY	3050	3750	1000	5725	—	—		15,000	—	30,000	30,000	30,000	30,000	30,025	—	500	700	2000	1000	2000	500	—
MAX DAILY VOL, GAL./DAY	20,000	14,400	1000	5725	—	4200		60,000	78,000	88,000	88,000	88,000	88,000	40,000	48,000	500	20,000	15,000	1000	2000	—	—
BATCH VOL, GAL./BATCH	450	900	900	900	1900	4200		15,000	17,000	30,000	5000	5000	5000	—	12,000	—	450	900	900	900	500	—
BATCH WT, LB/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
DRY SOLIDS WT LB/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
DRY SOLIDS WT %	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
DRY SETTLED SOLIDS DEN., LB/FT	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
NORMAL LIQ ACT CONC, µCi/cc	5E-2	1E-2	7E-5	2E-5	—	2E-2	•	3E-2	1E-2	2E-2	1E-2	1E-2	5E-4	—	2E-2	3E-6	7E-6	1E-6	1E-5	7E-7	2E-2	—
MAXIMUM LIQ ACT CONC, µCi/cc	1E00	1E-1	2E-3	1E-2	—	5E-1		3E-2	1E-2	2E-1	2E-1	2E-1	2E-3		6E-1	2E-4	7E-2	1E-3	4E-4	2E-5	—	—
NORMAL DAILY LIQ ACT, µCi/DAY	7E06	2E06	3E02	4E02	—	—		1E06	—	2E06	1E06	1E06	2E04	2E04	—	8E00	2E01	8E00	9E01	5E00	3E01	—
MAXIMUM DAILY LIQ ACT, µCi/DAY	2E07	5E06	7E03	3E06	—	1E06		1E06	—	3E07	3E07	3E07	3E06	3E06	1E07	4E02	2E06	8E03	1E03	1E02	—	—
NORMAL SOLID ACT, µCi/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MAXIMUM SOLID ACT, µCi/BATCH	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
FLOW, GPM	60	100	50	50	120	50		50	100	120	120	350	350	350	100	—	50	150	50	50	50	25
UNDISSOLVED SOLIDS, PPM	2	2	2	2	>1	10		125	80	30	1	1	<1	<1	80	—					—	—
CONDUCTIVITY, UMHO/CM					—			—	—	30	30			<1	30,000	—						—

STREAM NO. △	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
NORMAL BATCH/DAY	—	—	1	—	1/8		6/1	1/1	1/60		1/100	1/10	—	—	—	—		1/1.6	1/16	1/17	1/16	1/16
MAXIMUM BATCH/DAY	—	—	1/1	—	1/6		10/1	3/1	1/60		1/1	1/10	—	—	—	—		4/1	4/1	1/1	4/1	4/1
NOR DAILY VOL, GAL./DAY	1600	100	1100	1050	50		660	35	—		—	—	—	—	—	—		9000	8825	175	8825	8825
MAX DAILY VOL, GAL./DAY	1000	100	1100	1050	50		2000	100	—		8400	—	—	—	—	—		55,000	52,000	3000	52,000	52,000
BATCH VOL, GAL./BATCH	—	—	1100	1050	300		110	35	1900		8400	4300	—	—	—	—		14,000	13,800	3000	13,800	13,800
BATCH WT, LB/BATCH	—	—	—	—	—		800	300	17,000		72,000	36,000	—	—	—	—		—	—	—	—	—
DRY SOLIDS WT LB/BATCH	—	—	—	—	—		8	15	1350		8600	130	—	—	—	—		—	—	—	—	—
DRY SOLIDS WT %	—	—	—	—	25		1	5	8		11	0.3	—	—	—	—		—	—	25	—	—
DRY SETTLED SOLIDS DEN., LB/FT	—	—	—	—	—		8	8	9		24	13	—	—	—	—		—	—	—	—	—
NORMAL LIQ ACT CONC, µCi/cc	1E-8	1E-8	1E-8	—	3E-3		—	—	2E-2		—	7E-8	—	—	—	—		5E-3	5E-8	3E-1	5E-8	5E-7
MAXIMUM LIQ ACT CONC, µCi/cc	1E-5	1E-8	1E-4	—	3E-2		—	—	5E-1		—	3E-4	—	—	—	—		3E-1	3E-4	1.5E01	3E-4	3E-5
NORMAL DAILY LIQ ACT, µCi/DAY	3E01	4E00	3E01	3E-1	1E02		—	—	—		—	—	—	—	—	—		2E06	2E03	2E05	2E03	2E02
MAXIMUM DAILY LIQ ACT, µCi/DAY	3E01	4E00	1E03	1E01	1E03		—	—	—		—	—	—	—	—	—		1E07	1E04	1E07	1E04	1E03
NORMAL SOLID ACT, µCi/BATCH	—	—	—	—	—		—	—	1E08		6E06	3E04	—	—	—	—		—	—	—	—	—
MAXIMUM SOLID ACT, µCi/BATCH	—	—	—	—	—		—	—	3E08		3E07	3E06	—	—	—	—		—	—	—	—	—
FLOW, GPM	—	—	5	5	—		450		120		120	120	400	400	200	200		40	40	—	350	350
UNDISSOLVED SOLIDS, PPM	—	—	—	—	—		—	—	—		—	3000	—	—	—	—		65	1	—	1	<1
CONDUCTIVITY, UMHO/CM	2000	—	2000	20	—		—	—	—		—	—	—	—	—	—		16,000	16	—	16	<1

STREAM NO. △	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
NORMAL BATCH/DAY	0	0	—	—	—		1/35	1/225						1/30	1/30	2/6.6		13/1100	1/1100	1/1100	1/1100	6/1	15/60		36/300	3/350
MAXIMUM BATCH/DAY	—	—	—	—	—		—	—						—	—	2/1		1.6/1	—	—	—	18/1	15/60		36/1	2/14
NOR DAILY VOL, GAL./DAY	0	0	—	—	—		—	—								—		—	—	—	—	—	—		—	—
MAX DAILY VOL, GAL./DAY	52,000	52,000	—	—	—		2100	2100						—	—	4200		3300	2100	2100	2100	—	—		—	—
BATCH VOL, GAL./BATCH	—	—	—	—	—		2100	2100						30	30	2100		2100	2100	2100	2100	5	75		75	21,000
BATCH WT, LB/BATCH	—	—	—	—	—		18,000	18,000						—	—	18,000		18,000	18,000	18,000	18,000	30	205		560	—
DRY SOLIDS WT, LB / BATCH	—	—	—	—	—		4300	4300						—	—	75		4300	4300	4300	4300	11	90		240	—
DRY SOLIDS WT %	—	—	—	—	—		23	23						—	—	0.43		23	23	23	23	44	44		44	25
DRY SETTLED SOLIDS DEN., LB/FT	—	—	—	—	—		24	24						—	—	9		24	24	24	24	17	9		24	—
NORMAL LIQ ACT CONC, µCi/cc	—	—	—	—	—		7E-6	7E-6						—	—	2E-2		7E-6	7E-6	7E-6	7E-6	—	—		—	3E-2
MAXIMUM LIQ ACT CONC, µCi/cc	—	—	—	—	—		3E-4	3E-4						—	—	5E-1		3E-4	3E-4	3E-4	3E-4	—	—		—	1E00
NORMAL DAILY LIQ ACT, µCi/DAY	—	—	—	—	—		—	—						—	—	—		—	—	—	—	—	—		—	—
MAXIMUM DAILY LIQ ACT, µCi/DAY	1E03	1E03	—	—	—		—	—						—	—	—		—	—	—	—	—	—		—	—
NORMAL SOLID ACT, µCi/BATCH	—	—	—	—	—		9E06	2E06						—	—	1E08		6E06	9E06	2E06	1E05	1E05	2E07		2E05	—
MAXIMUM SOLID ACT, µCi/BATCH	—	—	—	—	—		6E07	2E07						—	—	2E09		3E07	6E07	2E07	1E06	1E05	5E07		8E05	—
FLOW, GPM	350	350	—	—	—		200	200								50		200	200	200	200	—	—		—	300
UNDISSOLVED SOLIDS, PPM	—	—	—	—	—		—	—								—		—	—	—	—	—	—		—	—
CONDUCTIVITY, UMHO/CM	—	—	>10	>1	>100		—	—								—		—	—	—	—	—	—		—	—

Table 3-2 (Continued)

LIQUID RADWASTE PROCESS INFORMATION (PER UNIT BASIS)

SERVICE STREAM NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
UTILITY	WTR	WTR		WTR	WTR			COND	COND	COND				STM	STM	STM	STM		AIR	AIR
PRESSURE, PSIG	50	50		50	50			50	50	50				100	30	30	50		10	100
FLOW, LB/HR, GPM, SCFM	50	2400		20	10			30	100	200					2E04	3E03			125	—
HEAT, BTU/HR	5E06	2E07		5E06	8E04			—	—	—				3E07	2E07	3E06	8E04		—	—
TEMPERATURE, °F	90	90		90	90			—	—	—				—	—	—	—		—	—

Table 3-3

LIQUID RADWASTE SYSTEM PROCESS EQUIPMENT

Equipment Name	Size	Quantity
Low-Conductivity Tank	57,000 Gal	2
Waste Filter	54 Ft^3	2
Filtrate Tank	3,000 Gal	2
Low-Conductivity Demineralizer	180 Ft^3	1
Backup Demineralizer	180 Ft^3	1
High-Conductivity Tank	18,000 Gal	3
Waste Evaporator	40 Gal/min	2
Concentrate Waste Tank	25,000 Gal	1
Distillate Tank	3,000 Gal	1
Distillate Demineralizer	180 Ft^3	1
Cleanup Phase Separator	12,500 Gal	2
Spent Resin Tank	10,000 Gal	1
Excess Water Tank	50,000 Gal	2
Detergent Waste Tank	1,500 Gal	2
Detergent Filter	25 Gal/min	1
Detergent Evaporator	5 gal/min	1

Table 3-4

EXPECTED DISCHARGE OF LIQUID
RADIOACTIVE EFFLUENTS FROM EACH REACTOR UNIT

Nuclide	Amount Released (Ci/yr)	Nuclide	Amount Released (Ci/yr)
Sr-89	2.3 E-5*	Br-83	1.3 E-4
Sr-90	1.7 E-6	Br-84	2.7 E-4
Sr-91	5.6 E-4	Br-85	1.8 E-4
Sr-92	1.0 E-3	I-131	1.1 E-4
Zr-95	3.0 E-7	I-132	1.1 E-3
Zr-97	2.5 E-7	I-133	7.4 E-4
Nb-95	3.1 E-7	I-134	2.3 E-3
Mo-99	1.7 E-4	I-135	1.1 E-3
Tc-99m	6.9 E-4		
Tc-101	1.4 E-3		
Ru-103	1.5 E-7		
Ru-106	1.9 E-8	Na-24	2 E-5
Te-129m	2.6 E-6	P-32	2 E-7
Te-132	1.1 E-4	Cr-51	5 E-6
Cs-134	1.2 E-6	Mn-54	4 E-7
Cs-136	8.0 E-7	Mn-56	5 E-4
Cs-137	1.8 E-6	Co-58	5 E-5
Cs-138	1.9 E-3	Co-60	5 E-6
Ba-139	1.5 E-3	Fe-59	8 E-9
Ba-140	6.7 E-5	Ni-65	3 E-6
Ba-141	1.8 E-3	Zn-65	2 E-8
Ba-142	1.8 E-3	Zn-69m	3 E-7
Ce-141	3.0 E-7	Ag-110m	6 E-7
Ce-143	2.7 E-7	W-187	3 E-5
Ce-144	2.6 E-7		
Pr-143	2.9 E-7		
Nd-147	1.1 E-7		
Np-239	1.9 E-3		

*2.3 E-5 = 2.3×10^{-5}

Table 3-5

EXPECTED DISCHARGE OF AIRBORNE EFFLUENTS
RESULTING FROM EVAPORATION OF DETERGENT WASTES
FROM EACH REACTOR UNIT

Nuclide	Amount Released (Ci/yr)	Nuclide	Amount Released (Ci/yr)
Sr-89	6.4 E-8*	Br-83	3.6 E-7
Sr-90	4.7 E-9	Br-84	7.5 E-7
Sr-91	1.6 E-6	Br-85	5.0 E-7
Sr-92	2.8 E-6	I-131	3.1 E-7
Zr-95	8.4 E-10	I-132	3.1 E-6
Zr-97	7.0 E-10	I-133	2.1 E-6
Nb-95	8.6 E-10	I-134	6.4 E-6
Mo-99	4.7 E-7	I-135	3.1 E-6
Tc-99m	1.9 E-6		
Tc-101	3.9 E-6		
Ru-103	4.2 E-10		
Ru-106	5.3 E-11	Na-24	6 E-8
Te-129m	7.2 E-9	P-32	6 E-10
Te-132	3.1 E-7	Cr-51	1 E-8
Cs-134	3.3 E-9	Mn-54	1 E-9
Cs-136	2.2 E-9	Mn-56	1 E-6
Cs-137	5.0 E-9	Co-58	1 E-7
Cs-138	5.3 E-6	Co-60	1 E-8
Ba-139	4.2 E-6	Fe-59	2 E-9
Ba-140	1.9 E-7	Ni-65	8 E-9
Ba-141	5.0 E-6	Zn-65	6 E-11
Ba-142	5.0 E-6	Zn-69m	2 E-10
Ce-141	8.4 E-10	Ag-110m	2 E-9
Ce-143	7.5 E-10	W-187	2 E-8
Ce-144	7.2 E-10		
Pr-143	8.1 E-10		
Nd-147	3.1 E-10		
Np-239	5.3 E-6		

* 6.4 E-8 = 6.4×10^{-8}

Table 3-6

ROUTINE RADIOACTIVE RELEASES IN GASEOUS EFFLUENTS
(μCi/UNIT/YR)
(Exclusive of detergent system effluents)

Isotope	Reactor Building	Radwaste Building	Turbine Building	Charcoal Bed Exhaust	SPE Offgas	Mechanical Vacuum Pump	Total μCi/Unit/Yr
Kr 85M	7.6(+ 6)*	--	1.0(+ 7)	--	--	--	1.8(+ 7)
Kr 85	--	--	--	5.0(+ 8)	--	--	5.0(+ 8)
Kr-87	5.1(+ 6)	--	1.9(+ 7)	--	--	--	2.4(+ 7)
Kr-88	1.0(+ 7)	--	4.0(+ 7)	--	--	--	5.0(+ 7)
Xe 133	2.0(+ 8)	--	5.1(+ 7)	--	--	2.3(+ 9)	2.6(+ 9)
Xe 135 m	7.6(+ 7)	--	1.1(+ 8)	--	7.1(+ 5)	--	1.9(+ 8)
Xe 135	7.6(+ 7)	--	1.0(+ 8)	--	--	3.5(+ 8)	5.3(+ 8)
Xe 138	2.5(+ 7)	--	2.0(+ 8)	--	--	--	2.3(+ 8)
I 131 E[a]	3.8(+ 3)	1.1(+ 2)	7.6(+ 3)	--	2.5(+ 3)	--	1.4(+ 4)
I 132 E	7.6(+ 4)	2.1(+ 3)	8.7(+ 4)	--	2.9(+ 4)	--	1.9(+ 5)
I 133 E	3.8(+ 4)	1.1(+ 3)	6.0(+ 4)	--	1.9(+ 4)	--	1.2(+ 5)
I 134 E	1.9(+ 5)	5.0(+ 3)	1.3(+ 4)	--	4.6(+ 4)	--	2.5(+ 5)
I 135 E	7.6(+ 4)	2.1(+ 3)	6.0(+ 4)	--	1.9(+ 4)	--	1.6(+ 5)
I 131 NE[b]	3.8(+ 3)	1.1(+ 2)	7.6(+ 3)	--	2.5(+ 3)	--	1.4(+ 4)

a. E = elemental
b. NE = non-elemental

*7.6(+6) = 7.6 x 10^6

Table 3.7

EXPECTED SOLID WASTE RADIOACTIVITY CONTENTS AND PRODUCTION RATES (PER UNIT BASIS)

	Cleanup Sludge and Spent Resin Containers (6.4 Containers/60 Days)		Filter Sludge and Concentrated Waste Container (1 Container/2.8 Days)	
Nuclide	Cleanup Sludge Curies/Container	Spent Resin Curies/Container	Filter Sludge Curies/Container	Concentrated Wastes Curies/Container
Na-24	8.5 E-31 *	8.5 E-05	0.	1.4 E-05
P-32	4.3 E-03	4.9 E-03	0.	1.1 E-04
Cr-51	7.5 E-01	0.	2.1 E-01	3.5 E-03
Mn-54	4.5 E-01	0.	2.0 E-02	4.0 E-04
Mn-56	0.	0.	9.9 E-02	2.3 E-10
Co-58	2.8 E+01	0.	2.3 E+00	4.4 E-02
Co-60	6.7	0.	2.6 E-01	5.2 E-03
Fe-59	2.8 E-01	0.	3.7 E-02	6.7 E-04
Ni-65	0.	0.	5.9 E-04	1.2 E-12
Zn-65	2.1 E-02	3.1 E-03	0.	2.2 E-05
Zn-69m	2.7 E-35	9.8 E-07	0.	1.5 E-07
Ag-110m	6.6 E-01	0.	3.1 E-02	6.2 E-04
W-187	1.8 E-19	0.	7.7 E-02	1.2 E-04
Br-83	0.	3.0 E-05	0.	2.5 E-10
Br-84	0.	4.7 E-07	0.	1.4 E-31
Br-85	0.	2.5 E-11	0.	0.
I-131	2.4 E-01	2.7 E+00	0.	5.8 E+00
I-132	0.	2.2 E-04	0.	9.3 E-10
I-133	1.2 E-20	4.7 E-02	0.	9.4 E-02
I-134	0.	2.2 E-05	0.	3.1 E-20
I-135	0.	4.1 E-03	0.	2.2 E-04
Sr-89	1.1 E+01	2.4 E+00	0.	2.4 E-02
Sr-90	2.8 E+00	3.6 E-01	0.	2.4 E-03
Sr-91	0.	7.4 E-04	0.	5.7 E-05
Sr-92	0.	1.8 E-05	0.	9.7 E-10

(Continued)

Table 3-7 (Continued)

EXPECTED SOLID WASTE RADIOACTIVITY CONTENTS AND PRODUCTION RATES (PER UNIT BASIS)

	Cleanup Sludge and Spent Resin Containers (6.4 Containers/60 Days)		Filter Sludge and Concentrated Waste Container (1 Container/2.8 Days)	
Nuclide	Cleanup Sludge Curies/Container	Spent Resin Curies/Container	Filter Sludge Curies/Container	Concentrated Wastes Curies/Container
Zr-95	1.8 E-01	0.	1.6 E-02	3.0 E-04
Zr-97	1.9 E-29	0.	5.1 E-04	3.3 E-07
Nb-95	8.4 E-02	0.	1.5 E-02	3.1 E-04
Mo-99	2.9 E-06	1.0 E-02	1.9 E+00	1.2 E-02
Tc-99m	0.	2.0 E-04	0.	3.0 E-06
TC-101	0.	1.8 E-10	0.	0.
Ru-103	4.9 E-02	0.	7.4 E-03	1.3 E-04
Ru-106	2.6 E-02	0.	1.2 E-03	2.3 E-05
Te-129m	3.2 E-01	0.	1.2 E-01	2.0 E-03
Te-132	2.1 E-05	0.	1.6 E+00	1.1 E-02
Cs-134	1.8 E+00	2.4 E-01	0.	1.6 E-03
Cs-136	1.3 E-02	2.0 E-02	0.	4.6 E-04
Cs-137	2.9 E+00	3.7 E-01	0.	2.5 E-03
Cs-138	0.	2.8 E-08	0.	5.9 E-31
Ba-139	0.	2.0 E-06	0.	5.8 E-15
Ba-140	1.0 E+00	1.6 E+00	0.	3.8 E-02
Ba-141	0.	1.0 E-09	0.	0.
Ba-142	0.	3.7 E-11	0.	0.
Ce-141	7.0 E-02	0.	1.4 E-02	2.6 E-04
Ce-143	3.3 E-16	0.	1.2 E-03	3.4 E-06
Ce-144	3.4 E-01	0.	1.5 E-02	3.0 E-04
Pr-143	5.8 E-03	0.	1.1 E-02	1.7 E-04
Nd-147	8.6 E-04	0.	3.9 E-03	5.2 E-05
Np-239	1.6 E-06	7.1 E-01	0.	9.2 E-02
Subtotal Curies/Container	5.7 E+01	8.5 E+00	6.8 E+00	6.1 E+00

(Continued)

Table 3-7 (Continued)

EXPECTED SOLID WASTE RADIOACTIVITY CONTENTS AND PRODUCTION RATES (PER UNIT BASIS)

Nuclide	Cleanup Sludge and Spent Resin Containers (6.4 Containers/60 Days)		Filter Sludge and Concentrated Waste Container (1 Container/2.8 Days)	
	Cleanup Sludge	Spent Resin	Filter Sludge	Concentrated Wastes
Bone Dry Waste, Pounds/Container	210	1,230	170	6,950
Total Curies/Container	6.6 E+01		1.3 E+01	
Total Net Weight[a] Pounds/Container	12,700		15,700	

*8.5E-31 = 8.5×10^{-31}

a. Includes Cement

Table 3-8

EXPECTED CONCENTRATIONS OF EFFLUENTS FROM
CCW COOLING TOWER BLOWDOWN

Parameter	Cumberland River Water Quality[1]	Effluent Guideline[2]	Maximum Stream Limit[3]	Natural Draft Cooling Towers CF=6.6[4,5] Effluent Concentration	Concentration in River After Mixing	Dilution Water Required
	mg/l	mg/l	mg/l	mg/l	mg/l	gal.
Dissolved Solids	80	--	500	536	126	0
Suspended Solids	32	40	--	211	50	0
Ammonia	0.002	5.0	(0.5)	0.013	0.003	0
Flouride	0.06	20.0	(1.0)	0.40	0.09	0
Chloride	3	--	(250)	20	4.7	0
Sulfate	25	1,400	(250)	170	42	0
Total Phosphate[6]	0.08	1.0	(0.08)	0.53	--	--
Silica	4.7	--	50[7]	31.0	7.3	0
Total Iron[6]	1.0	10.0	(0.3)	6.6	--	--
Manganese[6]	0.12	10.0	(0.05)	0.79	--	--
Copper	*	1.0	(0.02)	--	--	--
Zinc	0.02	2.0	(0.1)	0.13	0.03	0
Chromium	*	3.0	(0.05)	--	--	--
Aluminum[6]	1.6	250	(1.0)	10.6	--	--
Nickel	*	3.0	(0.1)	--	--	--
Silver	*	0.05	(0.005)	--	--	--
Sodium	3.4	--	(100)	24.5	5.9	0
Potassium[6]	1.9	6.0	(1.9)	12.5	--	--
Lead	*	0.1	(0.05)	--	--	--
Mercury	0.0006	0.005	(0.005)	0.004	0.0009	0
Barium	*	5.0	(1.0)	--	--	--
Arsenic	*	1.0	(0.01)	--	--	--
Cadmium	*	0.01	(0.01)	--	--	--
Selenium	*	0.01	(0.01)	--	--	--
Boron	*	500	(1.0)	--	--	--

1. Maximum concentrations of parameters in grab sample taken from Cordell Hull Dam tailrace (CRM 313.5) in May, July, and September 1973.
2. Established by Tennessee Water Quality Control Board, January 1973.
3. Sources of maximum stream limits are Tennessee water quality standards and (guidelines) and Water Quality Criteria.
4. CF (concentration factor): factor by which concentrations of parameters in raw river water are multiplied in heat dissipation system during 30-hour holdup of blowdown.
5. Maximum concentration factor expected during operation of plant.
6. Concentrations of these parameters in raw river water equal or exceed maximum stream limit.
7. Maximum stream limit was attained from Water Quality Criteria.

* Below detectable limits.

Table 3-9

Principal Tree Species in the Vicinity of the Proposed Power Line Right of Way

Species		Percent Distribution based on number of trees	Percent Distribution based on net cubic foot volume
Eastern Red Cedar	Juniperus virginiana	20.6	10.5
Black Oak	Quercus velutina	.5	2.2
Southern Red Oak	Q. falcata	6.9	5.7
Blackjack Oak	Q. marilandica	1.0	.6
Scarlet Oak	Q. coccinea	.8	1.7
Chestnut Oak	Q. prinus	.8	1.7
Post Oak	Q. stellata	2.5	1.7
Basswood	Tilia americana	.8	6.4
Blackgum	Nyssa sylvatica	.3	.6
Yellow-Popular	Liriodendron tulipifera	2.0	11.7
Box Elder	Acer negundo	.5	1.1
Ash spp.	Fraxinus spp.	1.8	2.8
Black Cherry	Prunus serotina	1.0	1.1
Elm spp.	Ulmus spp.	6.9	8.6
Hickory spp.	Carya spp.	22.6	15.9
Hard Maple	Acer saccharum	1.3	4.1
Persimmon	Diospyros virginiana	.4	.8
Black Walnut	Juglans nigra	4.2	4.1
Hackberry	Celtia occidentalia	15.3	11.8
Black locust	Robinia pseudoacacia	6.2	4.7
Honey locust	Gleditsia triacanthos	.3	.7
Osage orange	Maclura pomifera	1.3	.4
Sassafras	Sassafras albidum	2.0	1.1

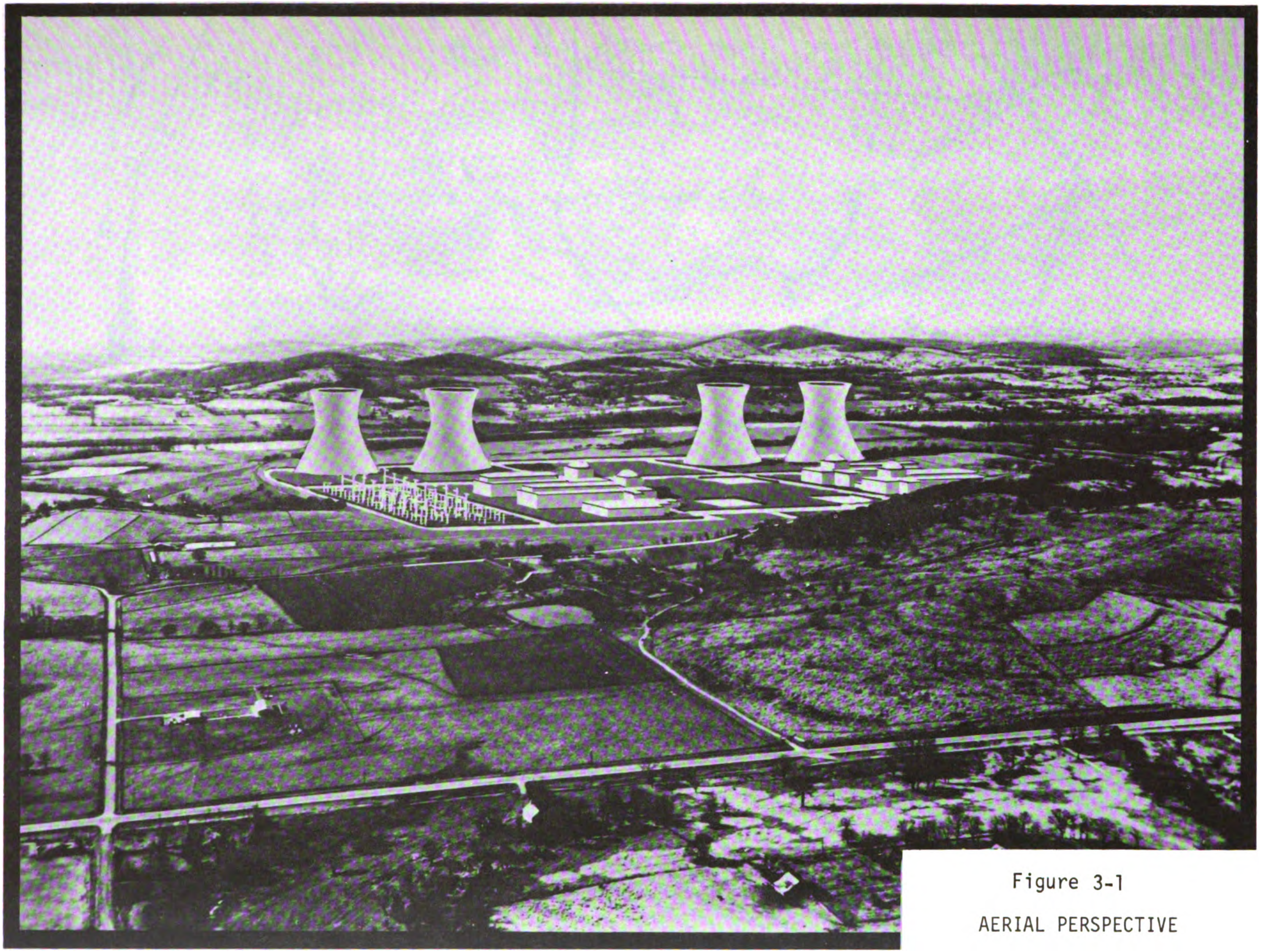
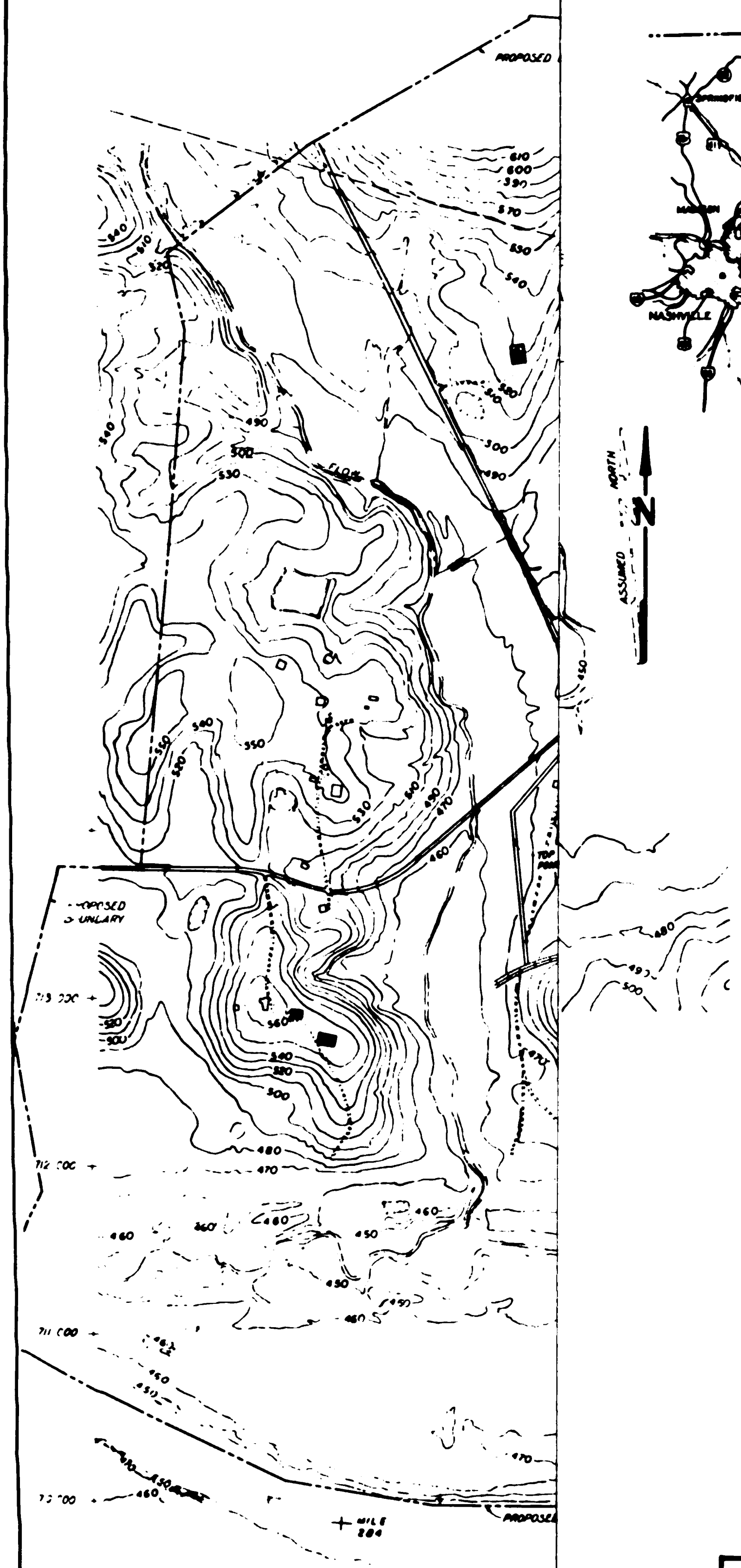
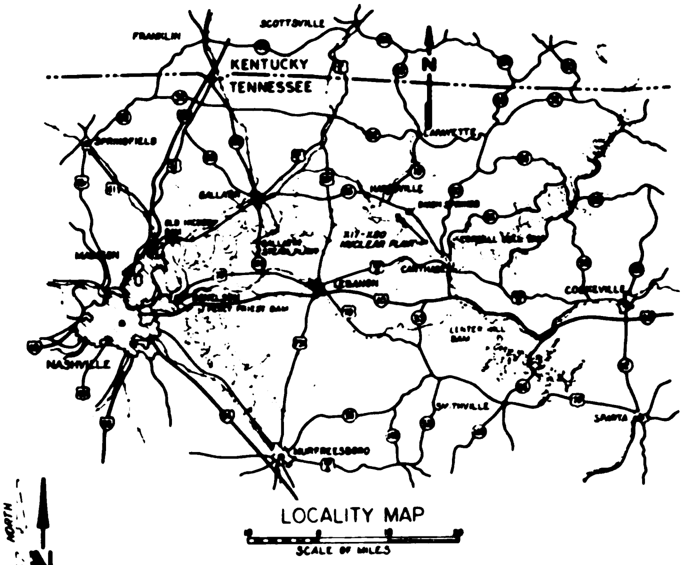


Figure 3-1

AERIAL PERSPECTIVE





1. TOPOGRAPHY TAKEN FROM KELSH TWO FEET CONTOUR TOPOGRAPHY DATED 1973, AND REDUCED. CONTOUR INTERVAL SHOWN IS 10 FEET, EXCEPT AS NOTED.
2. FOR CLARITY, BUILDINGS HAVE BEEN IDENTIFIED ONLY ONCE FOR BOTH PLANTS A & B. THE BUILDINGS AND BUILDING LAYOUT FOR BOTH PLANTS ARE IN MOST PART, IDENTICAL WITH PLANT B ROTATED 180° WITH RESPECT TO PLANT A. THE OTHER BUILDINGS ARE OPPOSITE HAND (SECURITY, OFFICE, SERVICE, ETC.)
3. TENNESSEE LAMBERT COORDINATES ARE INDICATED IN THE MARGIN.
4. THE TENNESSEE LAMBERT COORDINATES FOR THE INTERSECTION OF THE N-S AND E-W BASE LINES ARE: X-1,975,420.30 AND Y-714,156.67.

SCALE 400 0 400 800 FEET

Figure 3-2

PLANT LAYOUT

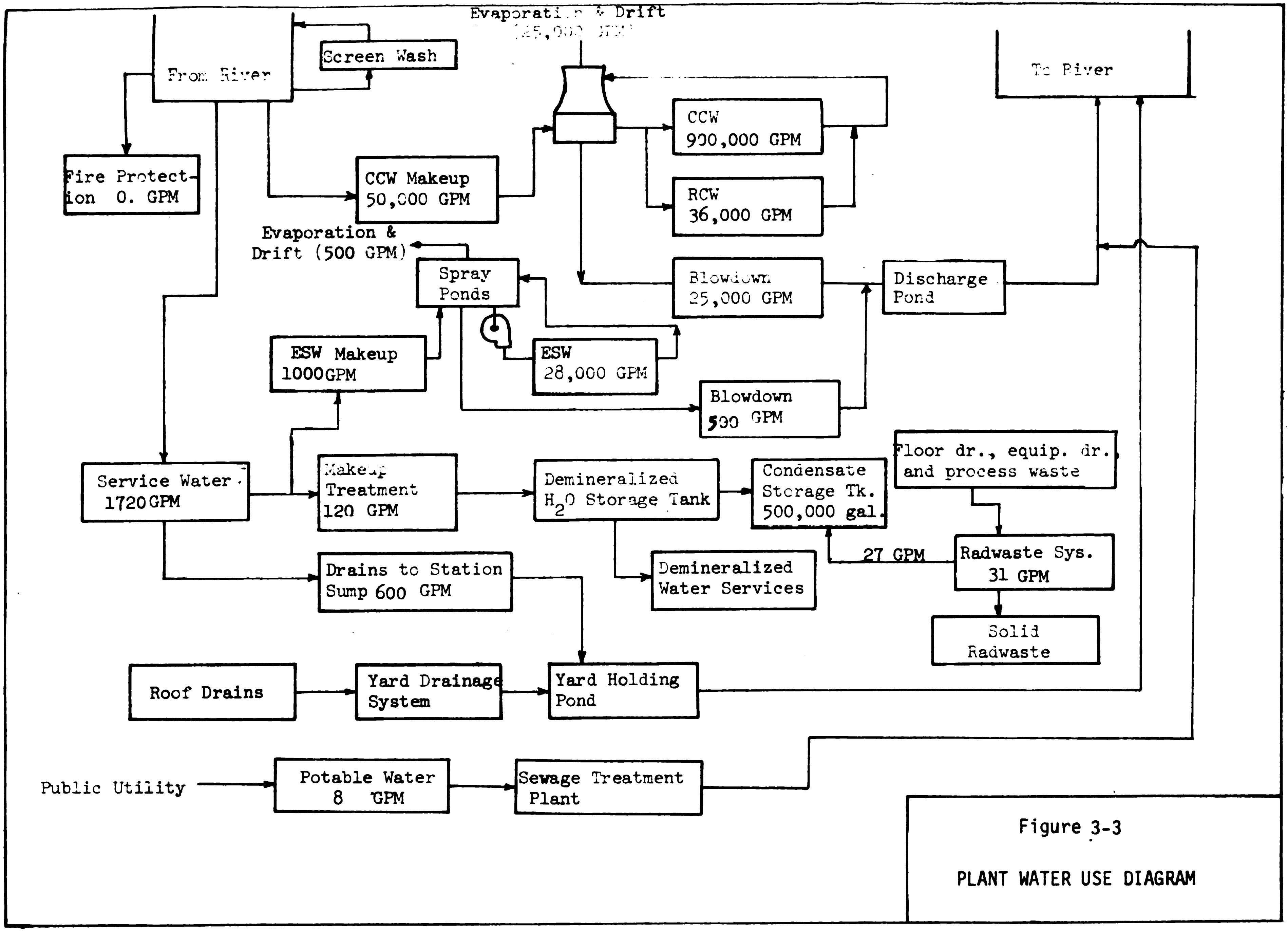


Figure 3-3

PLANT WATER USE DIAGRAM

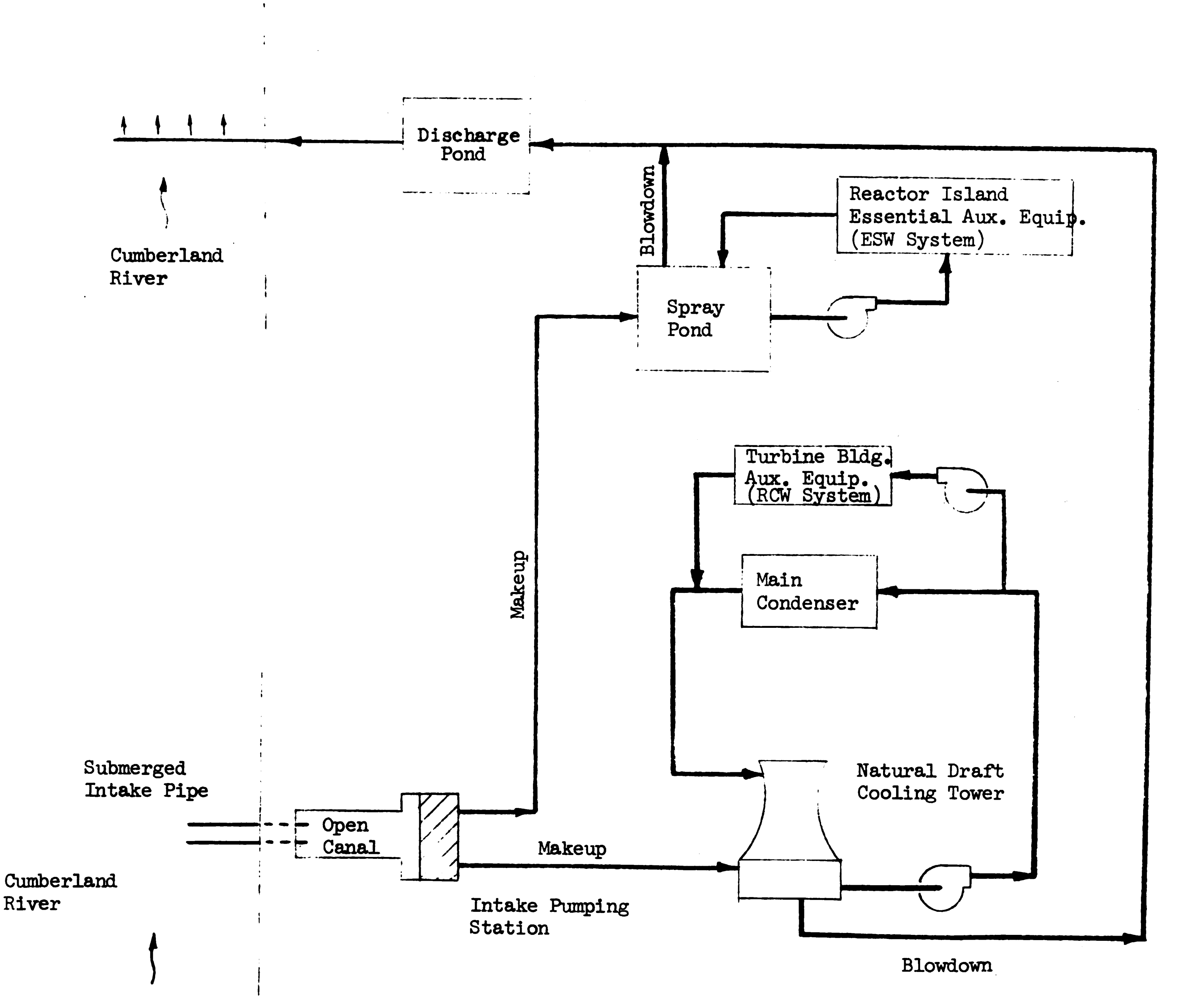
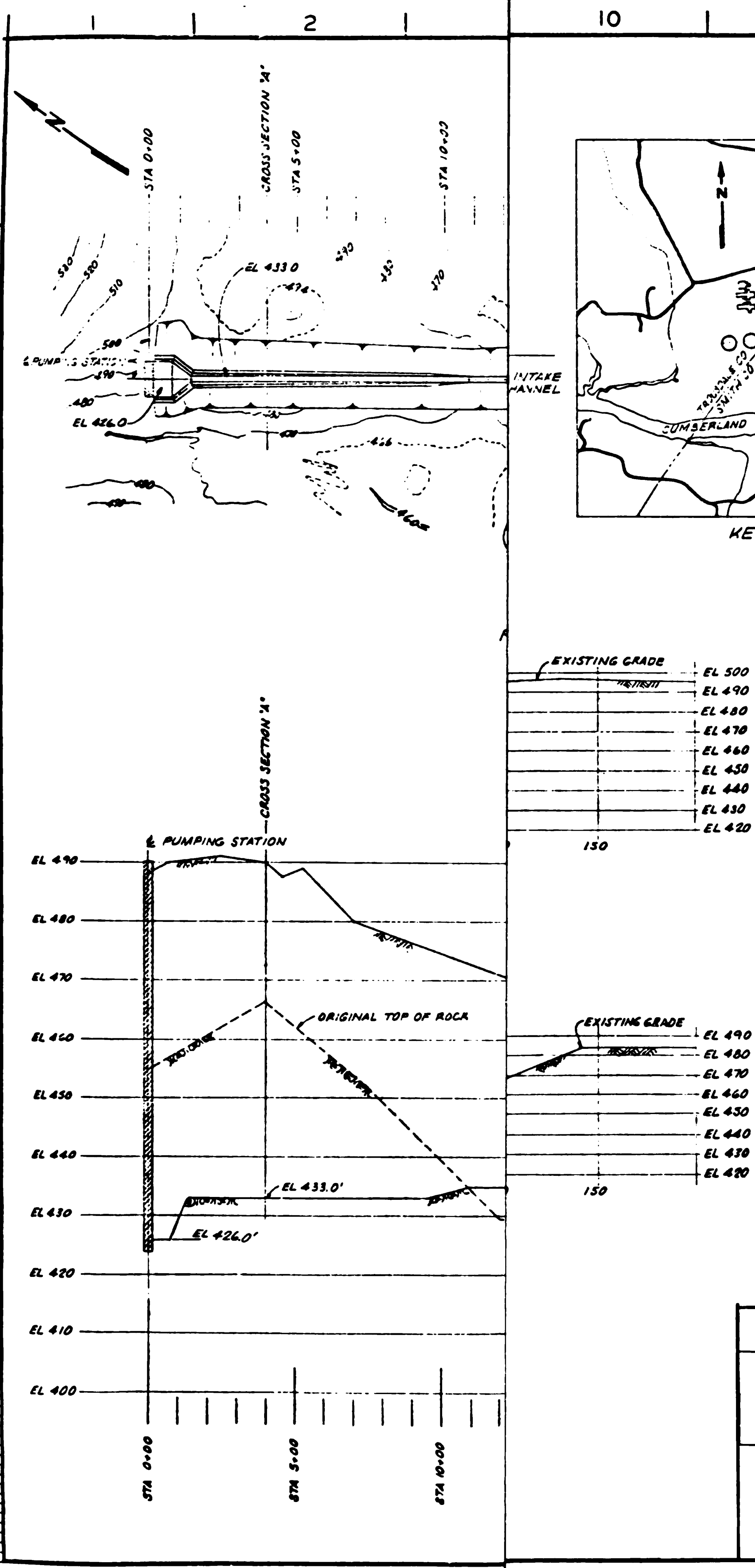
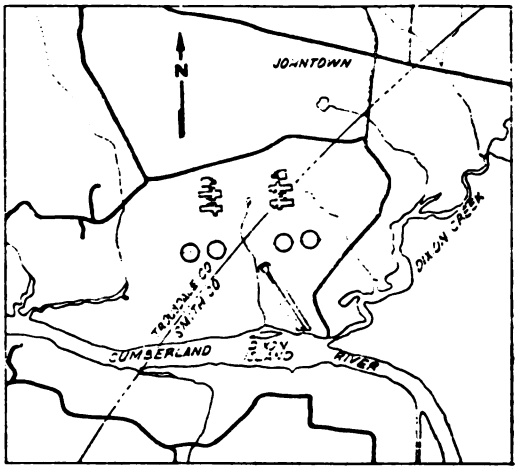


Figure 3-4

HARTSVILLE NUCLEAR PLANT

Heat Dissipation Diagram





KEY PLAN

Figure 3-5

WATER SUPPLY

PLAN & PROFILES
INTAKE CHANNEL

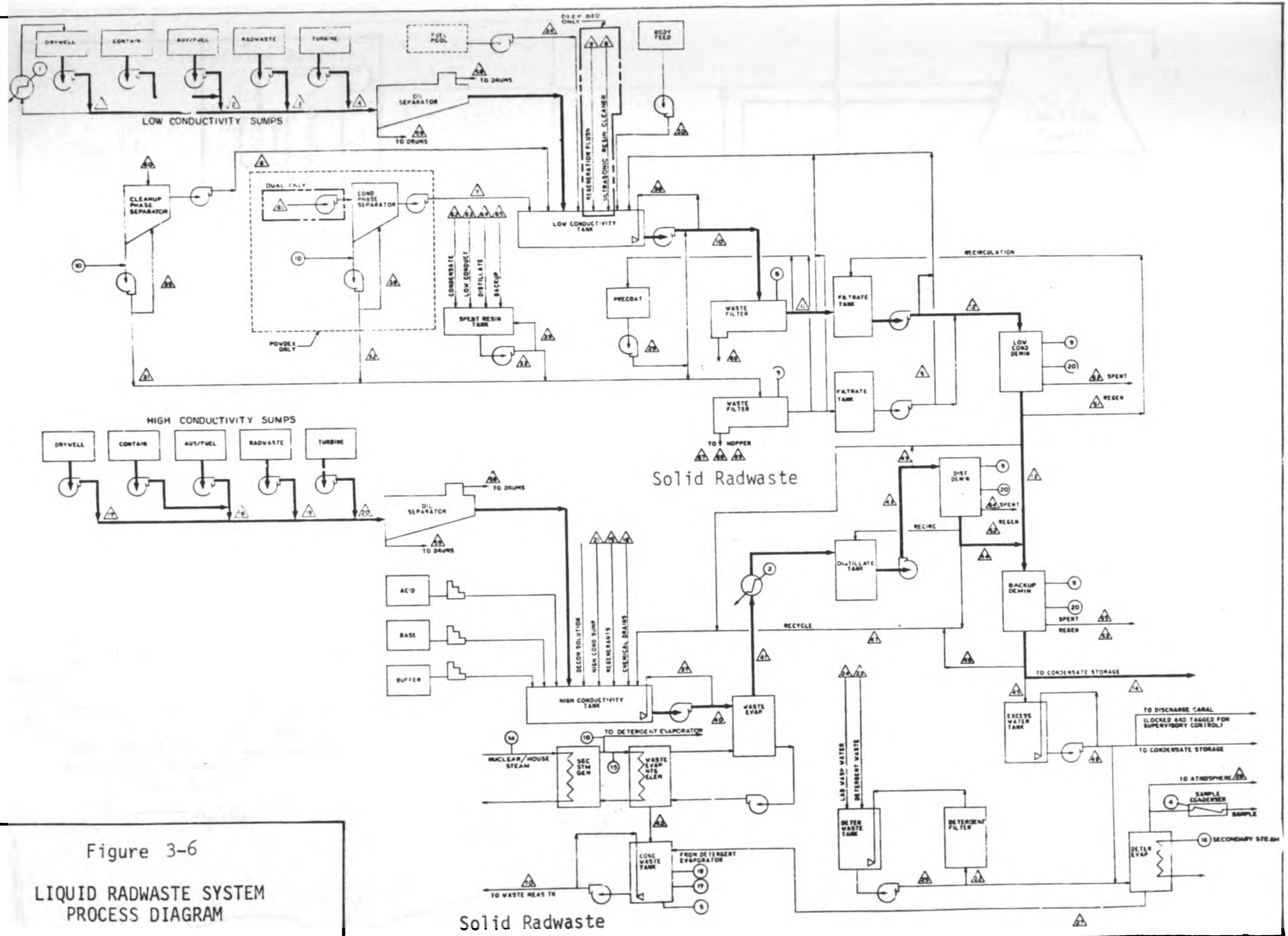


Figure 3-6

LIQUID RADWASTE SYSTEM PROCESS DIAGRAM

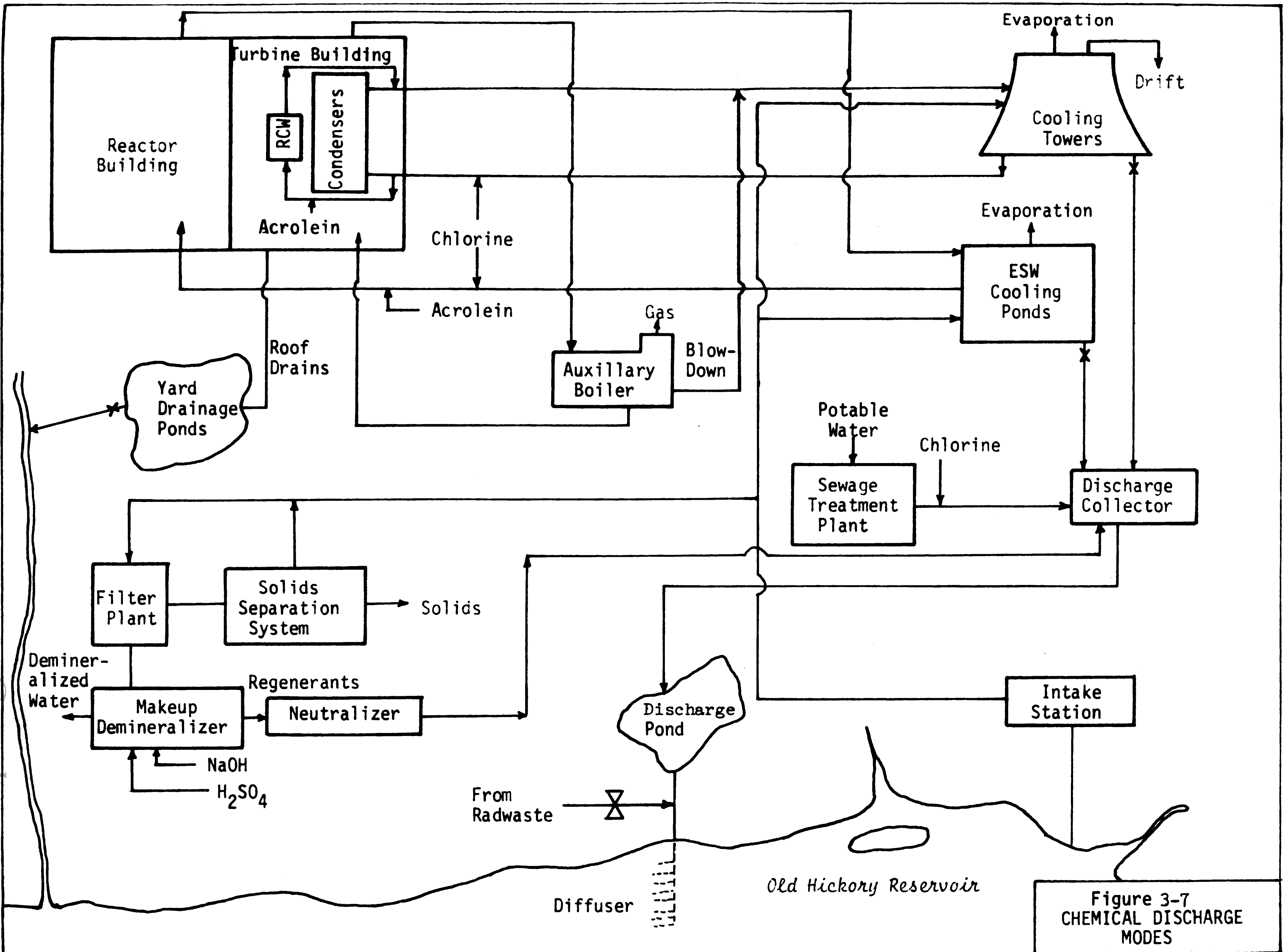


Figure 3-7
CHEMICAL DISCHARGE MODES

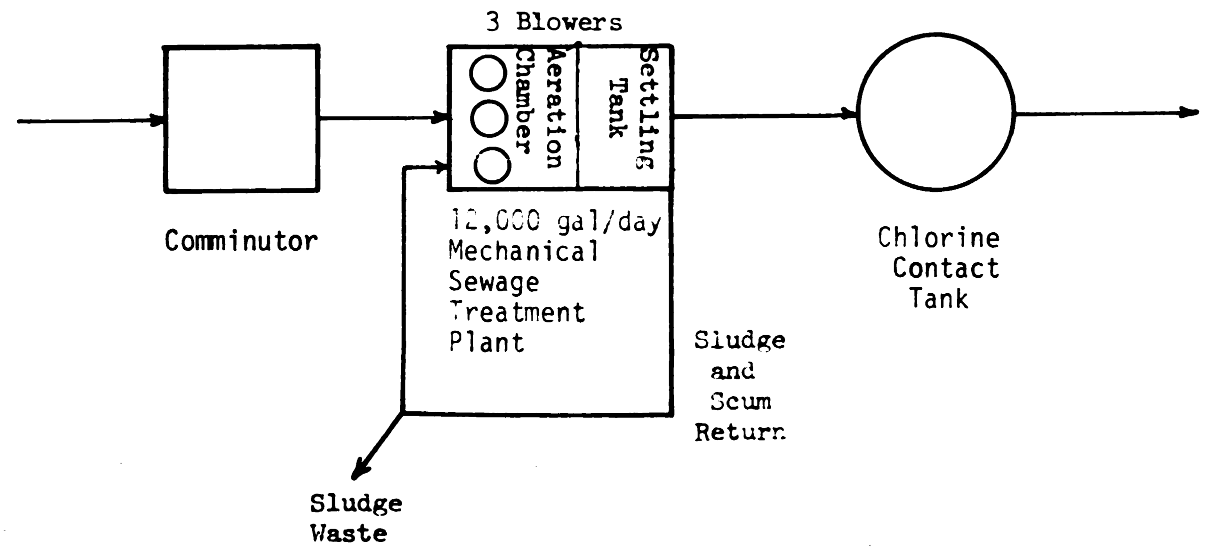
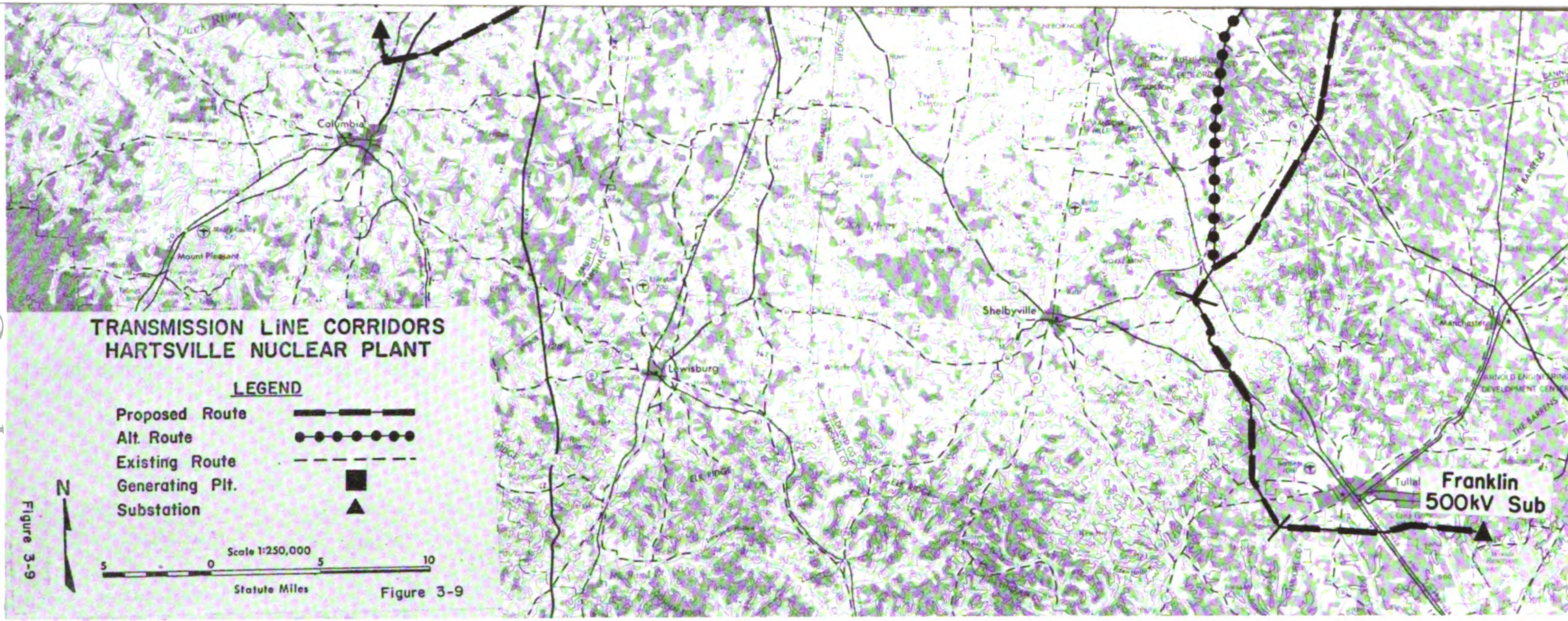


Figure 3-8

PACKAGE EXTENDED AERATION PLANT



TRANSMISSION LINE CORRIDORS
HARTSVILLE NUCLEAR PLANT
LEGEND
Proposed Route
Alt. Route
Existing Route
Generating Plt.
Substation
N
Scale 1:250,000
5
0
5
10
Statute Miles
Figure 3-9
Columbia
Mount Pleasant
Lewisburg
Shelbyville
Manchester
Tullahoma
Franklin
500kV Sub
Duck River
ELK RIDGE
THE BARRENS

Figure 3-9

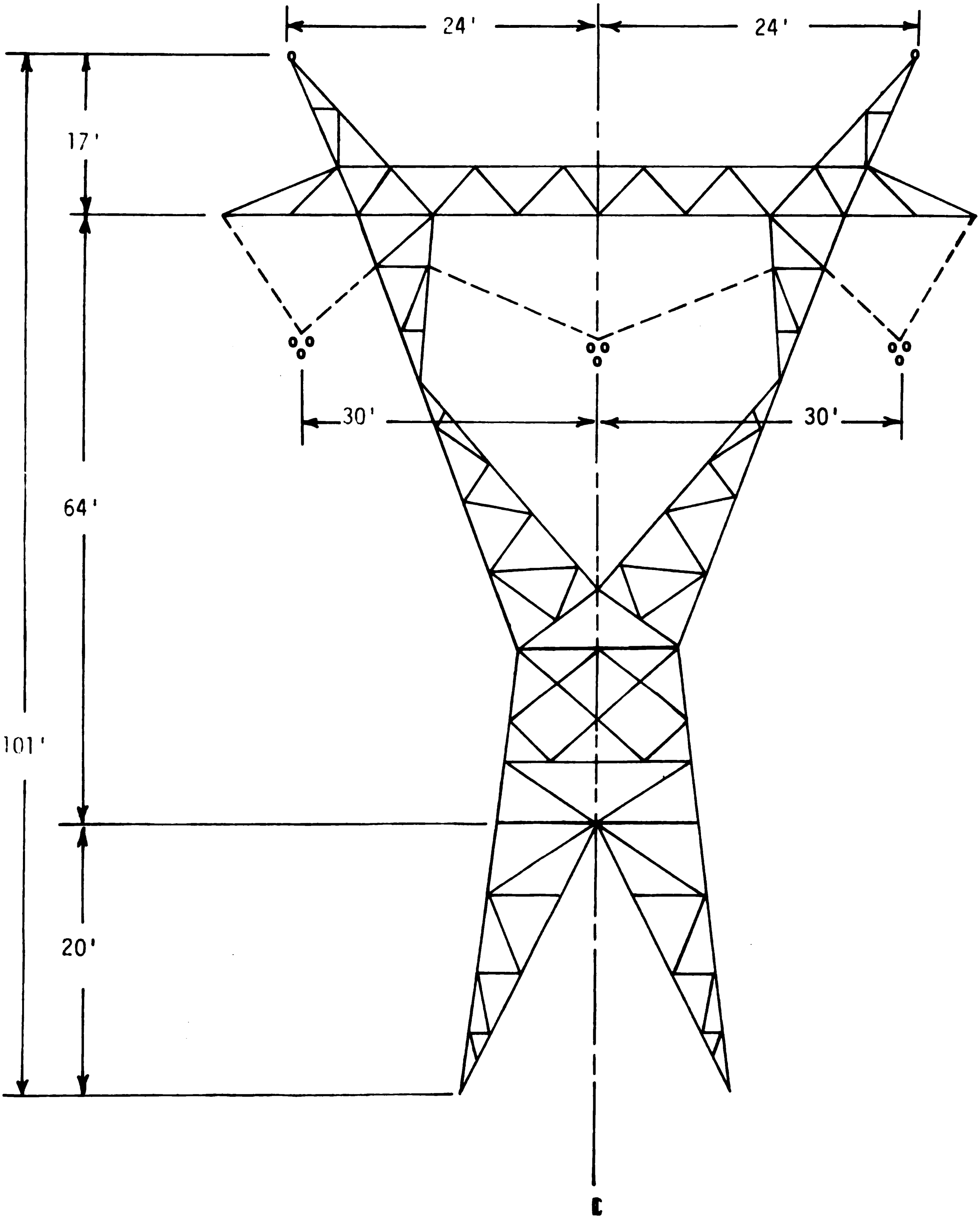


Figure 3-10

STANDARD SINGLE CIRCUIT
500kV TVA TOWER DESIGN

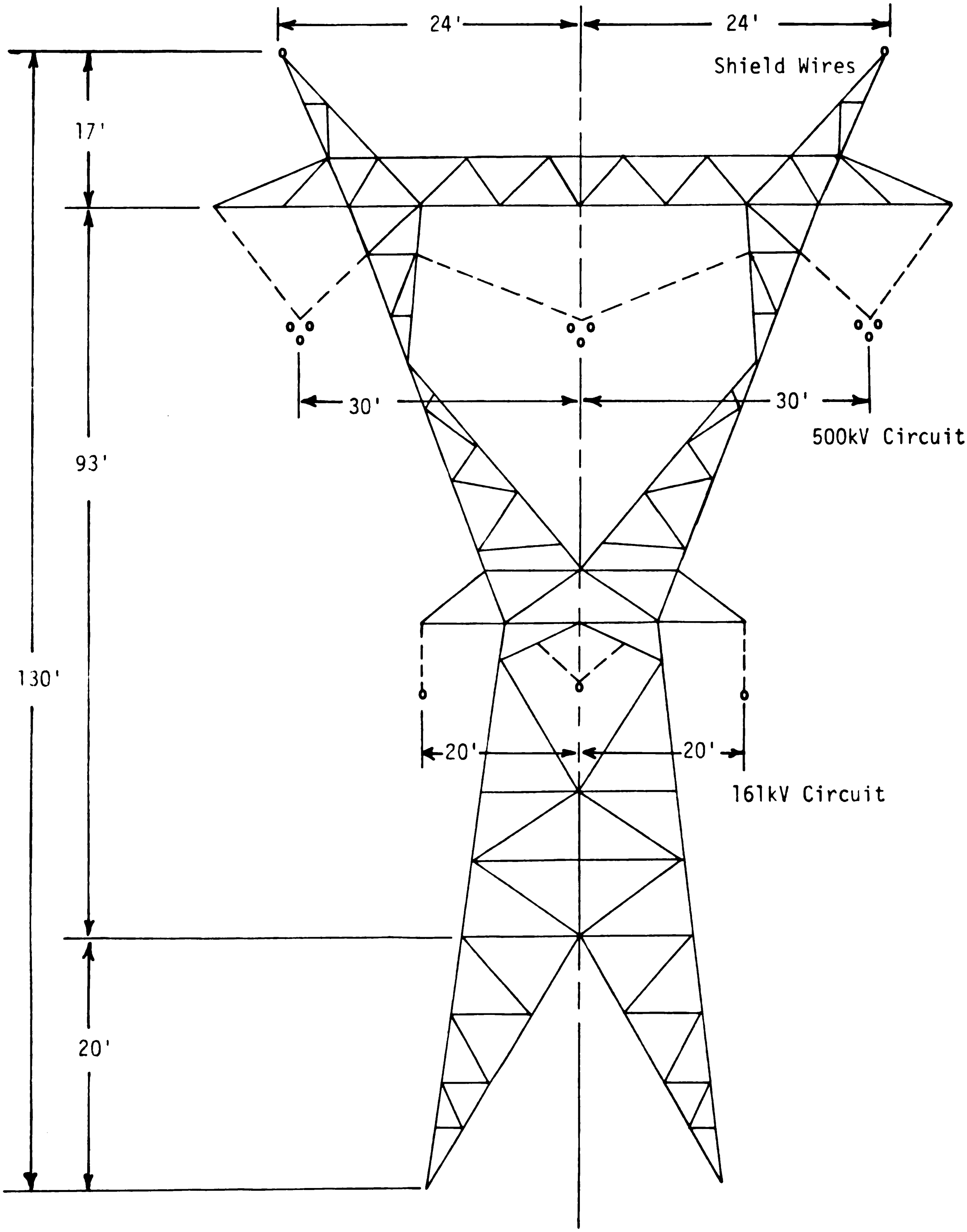


Figure 3-11

STANDARD DOUBLE CIRCUIT
500/161kV TOWER DESIGN

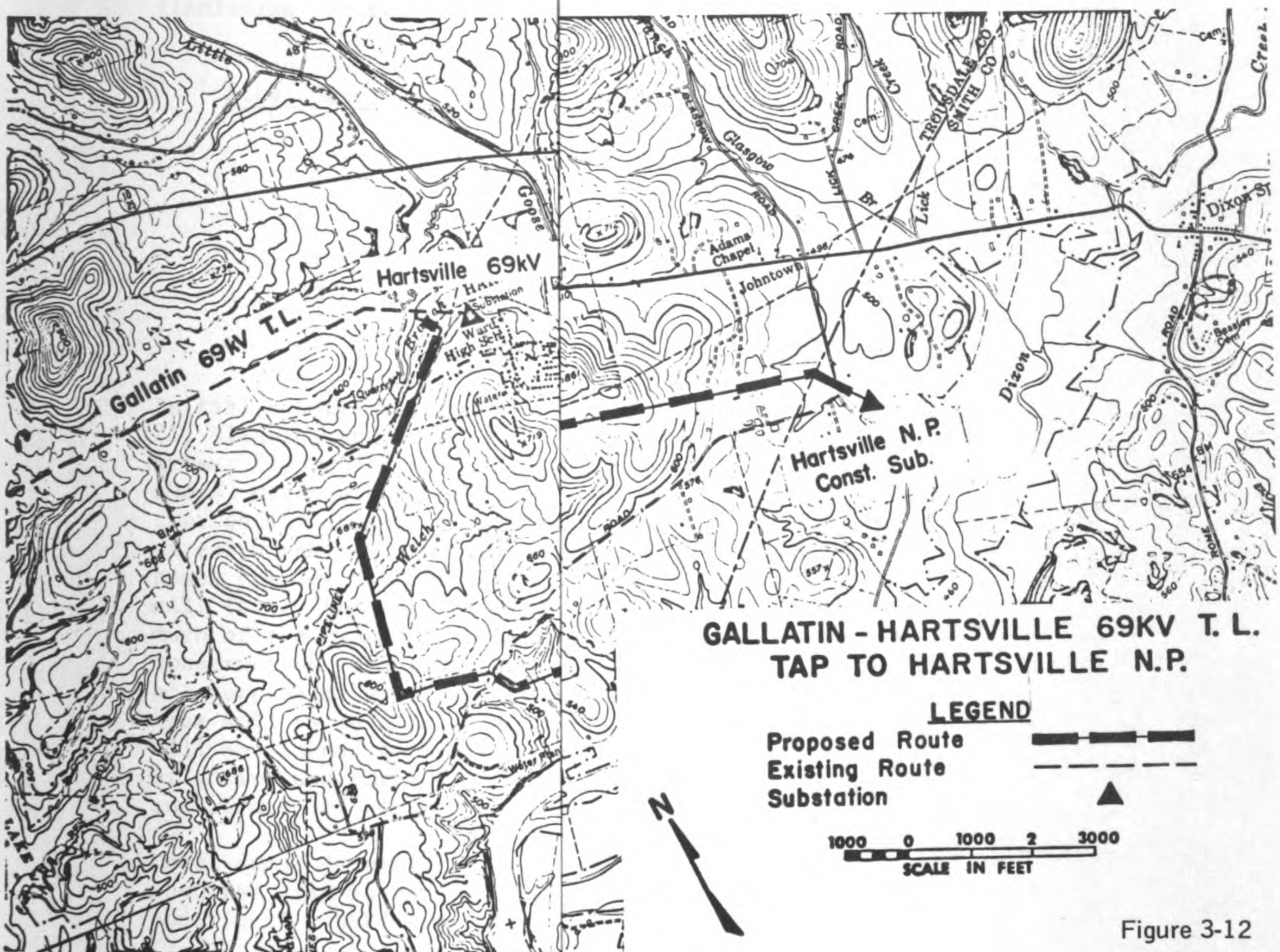

Gallatin 69kV T.L.
Hartsville 69kV
Substation
Hartsville N.P.
Const. Sub.
Adams Chapel
Johntown
Glasgow
TROUSDALE CO
SMITH CO
Dixon
GALLATIN - HARTSVILLE 69KV T. L.
TAP TO HARTSVILLE N.P.
LEGEND
Proposed Route
Existing Route
Substation
N
1000 0 1000 2 3000
SCALE IN FEET

Figure 3-12

4.1 Site Preparation and Plant Construction

Construction of the proposed Hartsville Nuclear Plant is anticipated to begin in April 1975 under a limited work authorization with commercial operation of unit 1 scheduled for December 1980. A total construction period of about 8 years forecasts employment levels of TVA employees (including contractors' workmen) over this period as follows.

Months After Start	Employees	Months After Start	Employees
3	500	51	5100
9	1600	57	4800
15	2700	63	4000
21	3800	69	3000
27	4500	75	2100
33	5000	81	1400
39	5300	87	800
45	5300	96	0

Initial construction work extending over the first two years will include: (1) Clearing and general grading of the plant site and construction plant areas; (2) erection of "Construction Plant Facilities" including various shops, warehousing facilities, utilities, concrete mixing plant, administration buildings, roads, railroads, etc. and (3) completion of excavation of earth and rock and yard fill placement in the area of the main powerhouse complex and for other permanent features. Equipment installation will follow the initial 6 months of concreting operations and extend over much of the remaining 8-year construction period. After completion of construction, all temporary construction facilities will be removed and all surplus material and equipment will be disposed of. The construction area will be left well landscaped. Construction activities at the site will be planned to minimize undesirable effects such as land erosion, siltation and turbidity in the reservoir, accumulation of scrap materials, and burning of cleared brush and trash.

Check dams, diversion dikes, sediment basins, and other control devices as required will be used in conjunction with seeding and mulching to provide additional runoff control.

4.1.1 Land Use Affected - Construction of Hartsville Nuclear Plant permanent features will require about 350 acres, about 75 acres additional for the access railroad and 350-400 acres for temporary construction facilities and borrow areas. Until the soils investigation program has been completed borrow areas cannot definitely be identified. At present it is planned to have all fill material, except for the access railroad, come from on-site sources. The access railroad is discussed later in this section under "Construction Plant Facilities." There are three areas that are being tested at present to determine their adequacy as borrow sources. The areas are as follows:

Area 1 - This area is within the confines of the yard drainage ponds and the discharge pond. This area was selected because it was close to a usage area and will increase the volumes of the ponds.

Area 2 - This area included the construction plant facility Areas A through H as shown on figure 4-1. The borrow in these areas is not included in quantity estimates for the construction plant given in the table in this section under general grading and excavation. These areas were selected because they were already disturbed during construction. When finished, the areas will be graded and seeded to blend with the terrain.

Area 3 - This area is near the western boundary of the site. It is bounded by the proposed boundary on the western side and by an unnamed creek on the north, east, and south. This area was selected because of the estimated availability of a large quantity of borrow. When finished, this area will be graded and seeded to blend with the terrain.

The land which will be disturbed has been generally cleared by previous owners and is very sparsely wooded. The powerhouse complex, including the switchyard and natural draft cooling towers, takes in an area of approximately 300 acres containing only a few trees and underbrush. The construction plant areas, which will total about 300 acres when developed, are tentatively located in mostly previously cleared areas. An area equivalent to about 25 acres may be affected by tree cutting and clearing. Merchantable timber will be offered for sale if feasible.

General Grading and Excavation - Following clearing and removal of stumps, top soil will be removed, stored and seeded as necessary for future use. Initial grading will consist of preparing some construction plant areas and grading main powerhouse and cooling tower areas down to design plant grade. Excavation and grading practices used will be those which will minimize effects on the environment. Check dams, diversion dikes, sediment basins, and other control devices as required will be used in conjunction with seeding and mulching to provide additional runoff control. General grading and excavation quantities are as detailed below.

	Cut (yd^3)		Fill (yd^3)	Dredge (yd^3)
	Earth	Rock		
Plant area grading	1,500,000	1,000,000	2,500,000	—
East yard dike	—	—	60,000	—
West yard dike	—	—	200,000	—
Intake channel	300,000	30,000	12,000	5,000

	Cut (yd^3) (Continued)		Fill (yd^3)	Dredge (yd^3)
	Earth	Rock		
Discharge pond	---	---	300,000	---
Construction plant	1,657,000	---	1,657,000	35,000
Subtotal	3,457,000	1,030,000	4,729,000	40,000
Borrow*	530,000	---	---	---
Shrinkage or swell	-597,000	309,000	---	---
Subtotal	3,390,000	1,339,000	4,729,000	40,000
TOTAL	4,729,000		4,729,000	40,000

The major portion of the intake channel will be excavated in the dry. Following completion of the channel, pumping station, and other work behind the dike the channel will be flooded by pumping from the reservoir and the dike will be removed. The corrugated metal pipes will be constructed on dry land, floated into place, and sunk and anchored. A dike to separate the channel from the reservoir will be constructed above the pipes.

Construction Plant Facilities - The building of construction plant facilities will be done concurrent with the grading and excavation program. This will begin with initial onsite work and all temporary facilities will be essentially complete within the first 2 years. There are no plans for new offsite road construction. Some repairs and modifications may be required to existing roads due to abnormal use during the construction program. These actions will be determined in concert with local highway officials.

The location and layout of the temporary facilities are tentatively designated in 14 areas, A through N, for potential development as shown in Figure 4.1-2. The areas contain a total area of 343 acres; from experience at our other nuclear plant construction sites we will probably develop a total of 250-300 acres. The areas and estimated excavation quantities are tabulated below.

*Until the soils investigation program and the design is completed, the exact quantities of borrow cannot be determined. The borrow listed in the above table is based on the assumption that the earth fill material will have 15 percent shrinkage and that the rock excavation is suitable to use as fill.

Area	Possible Use	Excavation Cut-yd^3	Excavation Fill-yd^3	Area Acres
A	Warehouse, yard storage	60,000	120,000	32
B	Shops, lumber storage	85,000	25,000	30
C	Parking	25,000	25,000	9
D	Parking	12,000	12,000	4
E	Warehouse, rail storage	600,000	600,000	77
F	Access corridor	90,000	—	17
G	Shops, resteel yard	240,000	330,000	42
H	Parking	—	—	7
I	Shops, lumber storage	300,000	300,000	26
J	Warehouse, yard storage	100,000	100,000	58
K	Parking	20,000	20,000	8
L	Parking	60,000	60,000	18
M	Concrete plant	50,000	50,000	10
N	Administrative offices	15,000	15,000	5
	Totals	1,657,000	1,657,000	343

The proposed permanent access railroad will consist of a 5.7-mile-long spur from the Louisville & Nashville Railroad Company line (Alternate B on figure 10-1). The proposed route would start in downtown Hartsville at the end of an existing spur and would dislocate two dwellings and pass through the back portions of several large residential lots presently abutting an industrial area. It would then cross near an open recreational field and pass near additional residences before entering the open, undeveloped area southeast of Hartsville. An estimated 75 acres will be utilized for construction of the railroad. Approximately 415,000 yd^3 of cut and 963,000 yd^3 of borrow will be required to construct areas.

Primary areas of environmental concern in railroad construction are solid waste disposal and erosion. Solid waste disposal methods will essentially be the same as those employed for the plant site. Limiting gradients, and rolling and seeding slopes as soon as possible will be among the measures employed to minimize erosion.

The construction railroad storage yard will be developed in a 75-acre previously cleared area. About 600,000 yd^3 of earthwork will be required to smooth the area. This area will be covered with broken rock or crushed stone as required to support lifting and hauling equipment. Some erosion can be expected, particularly during excavation, and runoff will probably increase due to surfacing. The area will drain toward the river; however, a vegetated area several hundred feet wide will provide a buffer which will intercept most of the suspended material before it reaches the river. If required, additional erosion control measures discussed previously will be used to further reduce siltation effects.

The concrete mixing plant and aggregate storage facilities will be developed on a previously cleared, 10-acre area north of plant A site. Waste water from aggregate rinsing and washing down of concrete mixing and hauling equipment is proposed to be routed to the yard drainage pond east of plant A.

The construction raw water system pumps will be mounted on two circular, sheet-pile cells driven in the vicinity of the proposed barge slip. Lines from the pumps will be placed in ditches with other service lines where possible. Some erosion may be expected from excavation of ditches and some increased turbidity will occur when the cells are being driven and minor dredging is taking place to provide adequate depth below minimum pool at the pump intakes.

A barge slip 50 by 150 feet will be constructed on the shoreline between the upstream tip of Dixon Island and the intake channel for offloading very heavy components and to handle other barge traffic for the project. Increased turbidity may be expected during the dredging operation and dike removal.

Solid Waste Disposal - Stumps and trees which are removed that cannot be sold will be cut, piled, and burned in compliance with applicable Federal, state, and local air quality regulations. There will be no burning of solid waste containing garbage. Metal, lumber scrap, and other salvageable material will be collected and offered for periodic sale and removal from the site. Broken concrete, rock, and residue from burning will be used as unclassified fill material onsite. Other solid wastes will be disposed of by appropriate methods.

4.1.1.1 Human Use Affected - Control will be maintained over noise, dust and erosion arising from site preparation so that no effects will be experienced offsite to significantly affect the present and expected human activities on land and water near and adjacent to the site.

4.1.1.2 Effects of Construction on Terrestrial Environs - Construction effects due to development of the Hartsville Nuclear Plant will occur in two general categories: (1) onsite habitat losses and (2) offsite habitat losses and alterations. Both adverse and beneficial effects will result. Adverse effects on terrestrial environs are expected to be minimal due to the small amount of woodland and riparian habitat that will be affected. Also, techniques to be utilized during the construction phase and considerations included in the selection, design, and location of plant subsystems will reduce adverse effects. Beneficial effects on the terrestrial environs insofar as wildlife is concerned will occur with the cessation of agricultural land use and the development of natural communities as plant succession takes place.

The wooded corridors along Dixon Creek, Cumberland River, and Dixon Island will not be affected by temporary or permanent facilities. The intake, discharge, and barge slip have been located to avoid these wooded habitats.

Changes caused by the cessation of agricultural operations are expected to include gradual shifts to natural upland habitat on lands now used for pasture and crops, an expansion of the wooded corridor along Dixon Creek and the Cumberland River and further development of cedar-hardwoods type on the knolls to the north and east of the plant.

Construction activities will result in increased noise levels, dust, silt deposition, and human activity. Also, the potential for accidental spills of fuels, oil, and chemicals will be increased. Off-site effects will result from development of rail access, borrow areas, transmission facilities, and the influx of construction personnel. Development of the proposed rail access will use approximately 75 acres, the large majority of which is used for agriculture. Rail access will involve crossings over Goose Creek and Corley Branch. Efforts will be initiated to reduce adverse effects during construction. The influx of construction personnel is expected to result in some land use shifts, primarily to provide housing. It is anticipated that a majority of these land use shifts will occur adjacent to existing communities and in areas now used for agricultural purposes.

Purchase of land for the plant will remove from agricultural use about 1,750 acres (excludes woodland) which was utilized for pasture, hay, and row crops as of December 1973.

4.1.2 Water Uses Affected

Erosion and Siltation - The amount of soil displaced by erosion due to construction and dredging is estimated to average 1,500 tons annually for 6 years. Care will be taken to minimize erosion losses during construction as much as possible by such practices as construction of diversion dikes, check dams, and sediment basins, utilization of mulches, and prompt establishment of grass sods on land which has been disturbed. Topsoil removed during initial land disturbance will be stored for use during final landscaping. Recommended fertilizer, liming, and land preparation, and seeding practices will be followed for establishment of erosion-controlling sod covers after completion of onsite construction. TVA inspectors and engineers will direct erosion control measures necessary to minimize the environmental impacts. TVA will also enforce erosion control considerations which will be part of the contract requirements for contracted construction services.

Present indications are that the excavation of the intake channel to the raw water pumping station, the barge slip, and the blowdown system diffuser are the only plant features where possible dredge or dragline operation along the waterfront would have an undesirable effect on the quality of the water in the reservoir. Special efforts will be made to minimize siltation in the reservoir; however, a certain amount of siltation is unavoidable.

Sanitary Wastes - Several temporary package-type aerobic digestion sewage treatment plants (12,000 gal/d) capable of handling the peak construction force sewage loads will be installed. The effluent from these plants will be treated and discharged into a detention basin or directly into the river. Appropriate NPDES permits will be obtained and their terms will be complied with. Chemical toilets will be used in isolated or remote areas during the construction period. Wastes from these toilets will be hauled to a local state-approved community sewage treatment plant for disposal.

Chemical Wastes - Chemical cleaning operations prior to unit startup will be conducted to minimize releases to the reservoir and to ensure that any chemical wastes released have been neutralized and diluted to concentrations which are acceptable for discharge into the reservoir. Waste water or waste solutions from cleaning operations will be directed to a pit for storage and treatment. Standard design and construction procedures will be utilized in construction of holding ponds. Quality control measures will be utilized to minimize the amount of chemical cleaning required.

Flushing Oils - Oils used during the cleaning process for transformer insulating oil systems and turbogenerator lube oil systems will be reconditioned for reuse or will be disposed of at some suitable offsite location.

Other Considerations - Excavation activities during construction may temporarily affect ground water movement in the immediate vicinity of the excavations, but the ground water movement should return to near normal after construction is completed.

Definite arrangements have not been developed at this stage for the potable water supply for construction plant and permanent plant needs. Present plans are to contract with the town of Hartsville to supply this need. Construction requirements could vary up to a peak use of 2,700,000 gal/mo during startup periods for the plant where high water usage is required in the plant flushing and cleanup cycles.

Raw water for construction needs in fire protection, equipment cooling, and other services will be pumped from the reservoir using two temporary pumping stations located at the waters edge near the plant site. This facility will have little effect on water quality or on flows in the vicinity of Dixon Island.

Pleasure and fishing boat traffic along this segment of the Cumberland should increase notably in the near future as a result of the recent formation of Cordell Hull Lake. Only minor, intermittent interference with navigational activities is anticipated and there should be a minimal impact on water recreation by site preparation and construction.

Construction Effects Upon Fish and Waterfowl - Construction activities will result in two effects on fish populations: (1) alteration of existing habitats by construction of the barge slip, intake and discharge facilities and (2) short-term increases in turbidity and sediment load during initial

clearing and grading of the plant site and construction of plant facilities, rail access, barge slip, intake and discharge structures. Principal effects on larval fish will be in these shallow areas which experience increased siltation and turbidity. Adult fish tend to avoid water of high turbidity but return when turbidity levels drop.

Construction of the intake, discharge, barge slip, construction raw water intake, road access, rail access, and transmission lines will not significantly affect riparian vertebrate populations. Migratory waterfowl feed in the grain fields on the site. Cessation of crop farming will remove this source of feed but will not have a significant adverse effect on this resource since there are plentiful forage areas in the immediate vicinity.

Other Biota - Some aquatic fauna in the lower portion of Dixon Creek and in the Cumberland River will be affected by the plant construction. The greatest effect on fauna of Dixon Creek will result from excavations for installation of the cooling water intake system. Damage to the reservoir benthic fauna population should be minor since a very small area of the reservoir will be affected as a result of constructing the proposed docking facility and the railroad access.

4.1.3 Miscellaneous Effects

Dust and Smoke - Sprinkler trucks will be employed on the construction roads and drives to minimize dust. Dust created in the concrete mixing plant operations will be controlled by use of filtering equipment and sprinklers if required. Burning of stumps, brush, small trees and other debris from clearing operations will take place under favorable atmospheric conditions and in accordance with local, state, and Federal guidelines.

Noise - Noise from blasting and construction equipment will be primarily during the daylight hours. The noise levels will be monitored and controlled if necessary to minimize disturbances to nearby residents and structures. New equipment will be purchased meeting applicable Federal noise standards as such standards become effective.

Historical - Plant construction will have no direct effect upon any National Register Property or any properties in the area which may be deemed eligible for the National Register except for increased traffic and noise during construction.

Archaeology - The Cumberland River valley has received little professional archaeological investigation. A comprehensive program of archaeological investigations is under way to ensure that adequate archaeological samples from the project area are removed and recorded; that appropriate salvage excavations are performed on significant interpretive archaeological sites that would be adversely affected by plant construction; and that these results are published for a better understanding of the prehistory of the area. Archaeological sites directly affected or endangered by the plant construction activities or the

presence of the plant facilities will receive necessary investigation as determined by TVA in consultation with the professional principal investigator and/or the TVA Board of Archaeological Consultants. Investigations and salvage operations will be based on priorities established in accordance with the construction schedule.

Major construction schemes (access highway, access railroad, power transmission lines, intake water systems, plant layout, and heat dissipation systems) are being carefully evaluated for known and suspected archaeological sites to ensure the appropriate investigatory archaeological program is utilized.

The preliminary archaeological surveys of the Hartsville site conducted in August 1972 located numerous areas of prehistoric habitation. The construction of the plant intake may affect two known potentially significant archaeological sites. One site appears to be a large Late Archaic site, dating 2,000 to 1,000 B.C. This site has a high priority for testing because investigation has indicated the possibility of an undisturbed midden deposit below the plow zone. The other site may be an Early Archaic site (7,000-5,000 B.C.) and will be further investigated to determine its significance. Archaeological surveys of the site are continuing in order to determine the significance of the identified sites and to locate other significant sites which may be directly affected by construction.

Cemeteries - There are two cemeteries which may be affected by the construction of the Hartsville Nuclear Plant. A small portion of Wright Cemetery which contains approximately 61 graves is inside the exclusion radius. The other cemetery (only one grave), which will require relocation because of the project construction, contains the body of Reverend John McGee. TVA will relocate these two cemeteries with the consent of surviving relatives and in accordance with state and county health regulations and under the guidance of the appropriate Federal court. The cemeteries will be placed in comparable or superior locations and conditions when relocated.

4.2 Socioeconomic Impacts

Acquisition of the Hartsville site will result in the displacement of 11 housing units associated with active farms. TVA's land acquisition policies provide for payment adequate to enable displaced families to reestablish themselves without economic loss. Persons dislocated by the project are eligible for relocation assistance upon proper application.

All properties purchased by TVA are appraised on the basis of the actual property value.

Under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, TVA will ensure that there will be available to those displaced by the project comparable replacement dwellings that are decent, safe, sanitary, and reasonably accessible to

their places of employment. In addition, provisions for relocation expenses, etc., are provided under this Act.

Other impacts will occur because of the large influx of construction workers. The five-county (Trousdale, Smith, Macon, Sumner, and Wilson) project Hartsville area can expect substantial, but temporary impacts (1) in the housing market with the attendant effects on land use, and (2) in demand for public and private services and facilities which will have to be accommodated (especially in the areas of schools, housing, and health services).

4.2.1 Magnitude of Impact - During its peak employment period there will be about 5,000 TVA employees at the project. Manpower requirements over time are in Section 4.1. Table 4-1 shows the estimated number of employees projected to move into the area (movers) in relation to total employees and the associated school-age children and total population over most of the 8-year construction period. While gasoline prices and availability may affect commuting/moving patterns, it is expected that an estimated 2,700 movers will locate near the Hartsville project during the peak employment. An estimated 65 percent of the movers will bring families, including an estimated 1,700 school-age children at the peak employment. In order to accommodate these school children, it is anticipated that the local school system will require approximately 60 classrooms and 28 60-passenger buses. There also will be an increased need for food services, pupil personnel services, administrative staff, desks, textbooks, library books, audiovisual aids and equipment, and supplementary materials.

Housing for the movers is expected to be equally divided between mobile homes and "conventional housing" (single family dwellings, apartments, and sleeping rooms). Table 4-2 shows the estimated need over time with a peak of 1,000 mobile homes, 700 single family dwellings, 200 apartments, and 100 sleeping rooms.

4.2.2 Distribution of Impacts - Table 4-3 contains the estimated distribution of movers at peak construction employment based on present conditions. Trousdale County is expected to get the largest share with 30 percent while Smith, Sumner, and Wilson Counties are expected to accommodate 20 percent each. The remaining 10 percent is expected to locate in Macon County. Also contained in the table is the estimated housing choice, school-age children, and total population influx for each county.

4.2.3 Ability of the Area to Accommodate - A desirable characteristic for an impact area to have is for its normal projected growth after construction to be on the order of the estimated employment impacts. Under these conditions, many impact-related mitigation efforts can be programmed to serve long-term growth. However, in the case of the Hartsville project, the combined nonproject-related expected growth of Smith and Trousdale Counties between 1970 and 1980 is 1,000 (from 17,600 to 18,600) and between 1970 and 1990, 3,200. Comparing this with a total projected project-related peak influx of 6,100 persons, it is evident that it would be uneconomical to propose permanent improvements to a level to serve temporary impacts. Thus, a combination of permanent and temporary mitigation measures will be needed.

Education - School systems in the five-county area around the project site have some excess capacity available for absorbing the additional student impact. However, while the total available classroom space in the project area as a whole might be adequate to absorb the additional students, the projected distribution of students among the five counties indicates there will be severe classroom and related shortages in the Trousdale and Smith County systems as noted below:

School System	Existing Excess Student Capacity	Estimated Student Influx	Projected Student Space Deficiency
Trousdale County	208	510	302
Smith County	0	340	340
Macon County	170	170	0
Sumner County	500	340	0
Wilson Co./Lebanon City	900	340	0
Total	1,778	1,700	642

County and Municipal Services - The influx of construction workers and related housing construction activity will cause an increase in demand for county and municipal services such as water supply, sewage facilities, and police and fire protection. Local governmental bodies in the five-county area which presently perform the planning, design, approval, and inspection functions in these areas will have to make provisions for the anticipated increase in work load.

Housing - Smith and Trousdale counties had about 65-70 vacant houses with complete plumbing for sale or rent in 1970 (1970 Census of Housing). This is clearly inadequate to meet the housing needs of movers and because of the low rate of growth in the area, very little speculative housing on the subdivision scale is built. In 1970, Sumner County had 528 vacant dwellings with all plumbing for sale or rent and Wilson County, 278, (1970 Census of Housing). The major communities in each county, Gallatin and Lebanon, respectively, are experiencing relatively strong rates of growth. Approximately 2,000 dwelling units will be needed. It is expected that mobile homes will comprise approximately one-half of the total housing requirements with the rest being conventional housing units. Conventional housing needs are expected to be largely met in Wilson and Sumner counties, while mobile homes are expected to be located much closer to the site in Trousdale, Smith, and Macon Counties. However, there may be little potential for the use of the mobile home development sites after plant construction is completed. Mobile home regulations exist only in Hartsville thus creating the potential of substandard mobile home developments occurring in the remainder of Trousdale County and in Smith and Macon Counties.

Traffic - State Highway 25 carried an average daily traffic (ADT) load of about 2,100 vehicles in 1972. The capacity for this type of road ranges from about 3,500 to 5,000 ADT. Peak construction traffic would add about 2,600, a combined total of 4,700. This would be a significant increase in traffic and could possibly result in an overload condition from an ADT standpoint. Since construction employee traffic

will be concentrated during the periods just before and just after working hours, an analysis of hourly capacity provides another viewpoint on potential impact. A road of this type can accommodate 1,150 to 2,000 cars per hour. Therefore, the road should accommodate the 1,500 cars expected during the change of the day shift. A mitigating factor is that the employees will be coming from both the east and west and an access road will be available at each end of the site. This will tend to reduce traffic conflicts.

Health Services - There exists a shortage of physicians and other primary health care providers in the five-county impact area, especially in Trousdale County which has only one physician in active medical care practice. The Public Health Department clinics in Smith and Macon Counties are currently understaffed and would need additional nursing staff to meet any appreciable increase in demand for clinic services. Existing and planned hospital facilities in the impact area will be adequate for meeting the anticipated demand for hospital beds. Emergency medical services are typical of those found in rural areas of Tennessee: ambulance services are provided by a number of small organizations; hospital emergency services are restricted by limited resources; and there is a need for improved communication between the various components of the emergency medical services system.

4.2.4 Mitigation Strategies - Definitive programs for helping the area accommodate and minimize the socioeconomic impacts have not been developed at this time. A number of strategies under consideration have been or will be discussed and evaluated with state and local bodies having relevant authority and expertise.

Education - Objectives of mitigation efforts would be to maintain the state teacher-pupil ratio, adequate classroom space, and transportation facilities. Efforts to prepare teachers and administrators to cope with the temporary increase in student population may include seminars and inservice education opportunities.

Classroom space will be the major problem during the construction years of this project. Both the Trousdale County and the Smith County systems are likely to need temporary school facilities.

TVA, in cooperation with State and local officials, will provide the necessary additional facilities and equipment (e.g. classrooms and busses) required to reasonably mitigate these impacts.

County and Municipal Services - There are presently no regulations to control mobile home development in Trousdale, Smith, or Macon Counties with the exception of Hartsville. TVA will take positive steps to assist the local governments in developing local planning programs and in considering appropriate local mobile home regulations. Specifically, to local governments who request aid, TVA is providing one-half of the first year local cost for technical planning assistance contracts with the Tennessee State Planning Office (TSPO).

TVA technical planning assistance also will be available to new and established local planning programs. For example, TVA will identify and promote various alternatives for accommodating temporary mobile home housing. Other potential problem areas such as law enforcement will receive technical planning help or other types of assistance as are reasonably necessary to mitigate project impacts. The increased demand for county and municipal services caused by the construction project can be met by TVA and the Tennessee Department of Public Health through the sharing of the cost of a full-time environmentalist to work in the project area.

Housing - Conventional housing demands by construction workers can reasonably be expected to be met. However, mobile home demand concentrated primarily in Trousdale, Smith, and Macon Counties will require increased local planning efforts. As discussed, TVA will continue to provide planning assistance to local governments in dealing with the anticipated influx of mobile homes. In addition, TVA will analyze the feasibility of privately developed mobile home parks in the area including estimating costs of development and necessary rental rates, assuming a complete amortization of capital investment. An alternative is permanent use of the facilities by designing, sizing, and laying out water, sewer, road, etc., to accommodate future permanent uses. Studies are underway to determine the feasibility of this concept.

Objectives of the housing mitigation strategy are to influence the distribution of the temporary population to (1) make the best use of available housing and public facilities and services, and (2) to encourage the conversion of temporary mobile home parks into permanent community improvements.

Traffic - Initial efforts will be directed toward encouraging car pools and possibly development of appropriate mass transportation facilities. TVA will investigate the feasibility of alternative programs for reducing traffic by selective location of housing and methods to expedite the flow of traffic at peak periods.

Health - TVA is exploring, with the Tennessee Department of Public Health, ways to improve availability of primary health care in Trousdale County. The Health Department, through its Primary Medical Care program, is considering the establishment of a primary care clinic in Hartsville, in cooperation with the one local physician there, and has requested assistance from TVA on this project. TVA is also considering a request from the Health Department for assistance in providing an additional public health nurse for meeting anticipated increased demand for clinic services in Smith and Macon Counties. The State Health Department has also requested assistance from TVA in improving emergency medical services in the impact area by (1) improved organization, (2) improved communication systems, (3) improved manpower training, and (4) improved interagency cooperative agreements between the various elements of the EMS system.

TVA will take necessary action, either directly or through assistance to other organizations, reasonably necessary to meet the health and medical care needs resulting from the project.

4.2.5 Economic Effects - Construction of the Hartsville project will generate economic activity in two ways: wages paid to construction employees and wages paid to "secondary" employees whose employment is a result of the economic activity created by the construction employees. Because of the additional wages paid in the area, retail sales and sales tax revenues, both state and local, will increase. Table 4-4 contains the estimated effects over the construction period. During the year of peak employment, construction wages will total $65,000,000, wages from secondary employment $11,500,000, retail sales $33,500,000, state sales tax $980,000, and local sales tax $323,000.

Changes in property taxes due to the project are discussed in Section 8.1.2 Payments in Lieu of Taxes.

4.3 Transmission Line Construction

Proposed transmission line connections to the Hartsville Nuclear Plant will interact with the environment in the areas traversed. While clearing of the right of way corridors and construction of the transmission lines will result in environmental impact, these impacts are not expected to be significant.

4.3.1 General Considerations for Locating Transmission Lines -

Topographic maps supplemented with aerial photographs are used to determine the best apparent route. A field reconnaissance is then made to check the routes. Engineers look for the best places to cross major highways and secondary roads, avoiding to the extent possible, residential, commercial, and industrial areas; recreational areas and other developments; and areas of historical, cultural, or scenic significance. Locations on crests of mountains and ridges are generally avoided to minimize visual impacts. Following completion of the engineering survey, competent archaeologists and historians are consulted. If any significant properties would be adversely affected by transmission line construction, the line location is reevaluated.

The transmission line structures are then located along the proposed route with full benefit of these consultations. Where the route crosses major highways, rivers, and other bodies of water, the structures are located to minimize visibility. Additional structure height may be provided to allow screens of existing vegetation to remain under the line at sensitive areas.

4.3.2 Impacts of Transmission Line Rights of Way Clearing and Construction Practices -

Shear Clearing - In constructing transmission lines through wooded areas, TVA "shear clears" the right of way (clearing of trees, stumps, and other vegetation to the ground level) except where outcropping of rocks, proximity to streams and road crossings, steep slopes, and other critical areas make it impractical. Hand clearing or spanning of vegetation is utilized where these exceptions are encountered. Removal of

stumps alleviates the continual problem of rapid regrowth which can occur when well developed root systems are left in place. This also facilitates the movement of construction and maintenance equipment along the right of way and avoids the necessity of constructing an extensive system of access roads to each tower location.

While the removal of vegetation from the right of way by shear clearing constitutes an impact on terrestrial plant and animal communities existing in the corridor area, the impact of shear clearing will be localized. The land pattern traversed by this proposed route is alternately open farmland, pasture land, and wooded areas. The impact is further reduced by TVA's practice of reseeding the right of way with pasture-type grasses and also by the natural invasion by weeds and plants during subsequent growing seasons.

The landowner is encouraged to maintain an appropriate grass or wildlife food and cover or to utilize the area for row crops when consistent with his use of adjoining land. Such uses enhance the appearance of the right of way and at the same time provide agricultural production and wildlife benefits.

Impact on Flora - The major impact to flora will result from the clearing of brushland and forested areas. These land cover types will be altered to a short rotation brush community situation. Plant succession continues for 3-5 years until further maintenance of the right of way is required.

Merchantable timber along the proposed right of way corridors will be marketed during clearing operations. The present estimated value of timber that will be removed is \$247,000 (pulpwood-\$28,980, sawtimber-\$218,020). The projected economic loss of timber productivity based on 1973 timber values and 45 cu. ft. of wood per acre per year, is an estimated \$15,854 or \$6.86 per acre per year (pulpwood-\$1,826, sawtimber-\$14,028). Although some economic loss of timber production will result from this clearing, it is possible that this loss can be offset by converting the cleared land into uses that would provide an equal or higher return than timber production.

Impact on Terrestrial Fauna - Habitat disturbance will occur during initial construction and subsequent maintenance work. Species inhabiting open areas where vegetation removal will not take place (pasture, cropland, etc.) will not be significantly affected by construction, operation, and maintenance procedures (e.g., grasshopper sparrow, meadow lark, cotton rat). In areas where major vegetation removal will take place such as old fields and second growth deciduous and coniferous forests, significant impacts to certain faunal species will occur (e.g., flying squirrel, pine mouse, wood rat, pine warbler, worm-eating warbler, and wood thrush). These impacts will be short-term or temporary for species preferring early plant successional habitats such as brushland (e.g., yellow-breasted chat, prairie warbler, cottontail rabbit, skunks, and numerous reptiles), but permanent or long-term displacement will occur for others (e.g., wood thrush, summer tanager, red-eyed vireo, wood rat, flying squirrel).

Impact on Waterfowl - Other than crossings at Old Hickory Lake (Cumberland River), corridors pass through areas of low waterfowl use. Although the proposed corridors do not traverse established waterfowl management areas, the Old Hickory Lake Canada goose flock is now expanding to outlying areas. Construction of the transmission facilities in the vicinity of Old Hickory Lake will be scheduled so to reduce effects on hunting and waterfowl nesting activity.

Impact on Rare and Endangered Species - Rare, endangered, unique, or unusual species or habitats are not known to occur within or adjacent to the proposed corridors.

4.3.3 Land Use Impact - The use of land for these transmission line corridors may in localized areas conflict with existing or proposed land uses. Generally, on flat land, 500-kV transmission line towers occupy approximately 0.18 acre of land (unusable for other purposes) per mile of length. The remainder of the right of way must only be kept clear of obstructions and is available for a variety of other uses. Virtually all agricultural uses can be continued once the power line is built. No future timber production will be permitted for the life of the line but ornamental and orchard trees are allowed with certain height restrictions.

4.3.4 Social and Economic Impacts - Considering the limited land and natural resources available for present and future goals, the use of high-voltage transmission facilities avoids the necessity of building a number of smaller lines. One 500-kV transmission line can transmit more power than ten 161-kV lines but requires only twice as much right of way as one 161-kV line. High-voltage transmission facilities serve more efficiently the large generating facilities required in an expanding electrical system. The continued availability of a reliable supply of electric power is also of economic and social importance.

Construction of the proposed transmission lines may also have adverse social impacts through displacement of some homes and other structures, minor interference with cultivation practices, and disruption of other human activities. Displacement of homes is probably the most significant. Every effort has been made to avoid route locations which pass through existing residential areas or near farmsteads. With the increasing concentration of electric power requirements near densely populated areas, some disruption of residential areas is often unavoidable. Should family relocations be required, assistance will be provided in accordance with Public Law 91-646, "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

Any damage to fences, gates, roads, bridges, and other structures will be paid for or repaired by TVA following construction. Landowners will be reimbursed by TVA for land and crops damaged by construction or later maintenance activity.

4.3.5 Impacts on Aesthetics - Transmission lines and the cleared rights of way have some visual impact. TVA makes every effort to route proposed transmission lines through open areas. Part of central Tennessee

is heavily wooded and it will be necessary to traverse some 2,311 acres of forest land. In siting the proposed route, TVA avoided to the maximum extent practical areas known for their scenic and recreational values. It will be necessary for these transmission lines to traverse or pass in close proximity to Old Hickory Reservoir, Overall Creek, the Harpeth and Duck Rivers, and several major highways.

A portion of the Harpeth River is designated as a wild and scenic river and a section of the Duck River is designated as a recreation waterway. Special considerations will be given in designing, clearing, and constructing the transmission facilities at these crossings. Adequate vertical and horizontal clearances will be provided to allow for vegetative spanning and no brushing or clearing will be performed for a minimum of 100 feet on either side of the rivers except for an occasional extremely tall tree which would make vegetative spanning impracticable.

Efforts will be made to reduce visual impacts at all major road crossings, particularly at interstate highways, by revegetation, employing angles in the line to avoid a corridor effect, and preserving existing vegetation in the vicinity of the crossings.

Other suggestions included in the U.S. Department of the Interior publication Environmental Criteria for Electric Transmission Systems will be considered and incorporated on the design of these lines where practicable.

4.3.6 Impact of Support Facilities - To keep pace with the growing demand for power, it is necessary to add substantially to both generating capacity and bulk power transmission facilities. To meet the anticipated power requirements in central Tennessee, 500-161-kV bulk power substations will be needed in the following general areas: The Columbia area (Maury) the Clarksville area (Montgomery), and the Tullahoma area (Franklin). These facilities will become part of the transmission terminal support facilities for the nuclear plant.

To provide data acquisition channels, telephone service, supervisory control and telemetering functions and pilot relaying and protection channels for integrating the additional transmission facilities associated with the Hartsville Nuclear Plant into the overall TVA power system grid, additions to TVA's existing microwave control system will be required. To receive or transmit microwave signals from one station to another, an unobstructed line of sight is essential. An obstruction may be circumvented by installing a passive repeater designed to deflect or redirect the microwave signals around the obstacle or by installing an active type repeater station which receives, amplifies and retransmits the microwave signals.

One connection into Hartsville will require the installation of a passive repeater station approximately 0.6 mile north of the nuclear plant on property purchased for the nuclear plant. The passive repeater station will consist of a 24-foot by 30-foot billboard type passive reflector located within a fenced area approximately 50-feet square. Total clearing will be limited to the site for actual placement and

construction of the facility. Selective clearing, removal of tall trees outside of this 50-foot area will be required to provide an unobstructed line of sight. This would connect the transmission facilities control system into the existing Russell Hill Microwave Station approximately 12 miles east-northeast of the Hartsville plant site. Lower growing trees and brush will not interfere with the line of sight.

The second connection would be established by way of a new, two-hop microwave system to be installed between the Hartsville Nuclear Plant and the South Nashville 161-kV Substation with a proposed intermediate active-type repeater station to be located near the community of Oakland, Tennessee. The installation of the active repeater site will require the purchase of a 5.5-acre site. Access to the site will be provided by the gravel road which follows along the lower slopes of the selected knoll. A short section (approximately 800 feet) of new access will be required from the existing road to the top of the knoll. No potential erosion problems are anticipated since the land is open and presently in permanent pasture. The repeater station will consist of a fenced metal building approximately 10 feet by 20 feet and a 350-foot guyed laced tower. Aircraft hazard painting and lighting will be installed on the proposed tower in compliance with FAA regulations. The proposed site will be coordinated with the Tennessee State Planning Commission-Regional Planning office and the Mid-Cumberland Council of Governments.

4.3.7 Solid Waste Disposal - TVA contracts most right of way clearing for the construction of transmission lines. Where practical, merchantable timber is marketed and disposal of slash cleared from rights of way is generally by controlled open burning which is performed in compliance with local, state, and Federal air pollution guidelines and ordinances. In locations where disposal by burning is not desirable, slash will be piled in windrows along the edge of the right of way. Minor construction waste items will consist of protective wood cribbing attached to conductor reels, cardboard shipping cartons and steel bands used to bind tower structural items and other line hardware. This waste will be returned to staging areas for disposal. At staging or material assembly points, relatively large quantitiesof the used packing material which accumulates will be transported to state-approved sanitary landfills or controlled burning.

4.3.8 Erosion Control Practices - Construction of these transmission lines will involve the use of heavy equipment for tower erection and stringing of conductor. Precautionary measures will be taken so that the effects of soil erosion on local water quality are not significant. The erosion of local areas will be controlled to a significant degree by: (1) using special construction procedures which limit the use of heavy equipment in areas of high erosion potential, directing runoff from exposed land to settling ponds, and keeping vegetation on the land as long as possible before construction; and (2) scheduling construction activities in swampy or wet areas to coincide with favorable dry weather conditions.

When line construction activity is completed, the rights of way will be contoured and seeded with pasture-type grasses or planted in wildlife

food and cover to control soil erosion and provide wildlife habitat. Access road routes will be selected to minimize damage to existing growth and drainage ditches, water breaks, and terracing.

4.3.9 Access Road Construction - During construction, access roads will be held to a minimum and efforts will be made to limit them to the tower sites. All tower sites, however, cannot be located adjacent to existing roads (field, farm, county, or state) to provide reasonably easy access. It is estimated that new access roads will average two per mile, 0.3 mile in length and 12 feet in width.

4.4 Commitment of Resources Due to Plant Construction

4.4.1 Loss of Land - The commitment of land involved in construction of the plant and related facilities is temporary in nature; and while it will be altered by construction activities, this does not represent irreversible or irretrievable losses of the land resource. Of the 1,940 acres acquired for the plant site, the powerhouse complex including switchyard and cooling towers will occupy approximately 300 acres. Two temporary construction areas adjacent to the plant will occupy approximately 150 acres each. Planned transmission facilities will utilize an additional 5,400 acres of land. The access railroad will require about 75 acres for the line and about an additional 60 acres for borrow areas.

Some land within the exclusion area of the plant will be altered by construction but revegetated when construction is completed. The major land use alteration will be cessation of existing agricultural operations.

Because most of the affected area is in agricultural use, the effect on the terrestrial communities is not considered significant. The long-term effect will be increased diversity and complexity of terrestrial communities. The loss of agricultural land for the life of the plant will be a commitment of resources. (See Section 2.2.2 of the environmental report).

Several areas on the site are suitable for industrial development, and much of the site is also suitable for residential development. It does not appear that any of the site would permanently lose its suitability for residential or industrial use although this would depend, to some extent, on the final disposition of the physical plant and related facilities at the end of the plant life, e.g., whether the structures were torn down. Thus, there would be insignificant permanent loss of land for industrial, residential, or agricultural purposes as a result of constructing the plant and related facilities.

The use of land at this site for plant and transmission facilities will not adversely affect present or future recreation activities. To some extent, construction of the nuclear plant should enhance area recreation by providing the visitors center and overlook.

4.4.2 Nonrecyclable Construction Materials - The major nonrecyclable construction materials committed to the project are concrete, including reinforcing steel and other embedded items. Quantities involved are in the range of 600,000 yd^3 of concrete; 30,000 tons of reinforcing steel bars; and miscellaneous embedments such as structural equipment anchorages, pipe, electrical conduit and boxes, waterstops, etc. Also, other materials which may be used for architectural treatment of buildings such as roofing, floor coverings, plastering, etc., may not be reclaimable.

Construction of the plant will also require the commitment of amounts of gasoline, diesel oil, electricity, and other energy resources required for operation of construction equipment and facilities. Minor amounts of various chemicals used throughout the project for such things as water treatment, preservatives, possible chemical cleaning of piping and equipment, etc., will be consumed and hence irretrievably committed.

Other major construction materials used, such as steel, wiring, and equipment, could be salvaged and recycled and therefore, these resources would not be irreversibly and irretrievably committed.

4.4.3 Destruction of Biota - Some commitment of resources will occur due to the destruction of biota caused by construction of the plant. This destruction may include direct destruction due to mechanical operations, blasting, and other construction activities, and indirect by the disturbance of the natural habitat.

Human activities, particularly land cultivation, have continually disrupted natural plant communities and interrupted natural ecological succession leaving little of the area in a relatively undisturbed state. No rare or unusual species or floral associations have been observed during studies to date. Therefore, construction techniques discussed in Section 4.1 such as avoiding key wildlife areas such as Dixon Island and the upland areas in the northern part of the site will minimize the destruction of habitat and displacement of faunal species.

It is expected that approximately 350 acres of terrestrial habitat will be lost due to the paving, building construction, and excavation of the permanent facilities. An additional 350-400 acres will be used for the temporary construction facilities. Wooded areas constitute about 25 acres of this committed habitat. The habitat loss within the permanent plant area is considered an irretrievable loss, but the construction areas will be committed only during the time of construction. After cessation of activity, they are expected to become productive natural habitats.

In addition to the areas on site, about 75 acres of habitat will be committed by construction of the access railroad. As with the plant site, most of this is farm land and construction of the railroad will not cause a significant loss. Crossings will occur over Goose Creek and an unnamed creek which are richer habitat areas. The crossings will occupy

only a small portion of the total habitat of these areas and will not result in a significant loss when compared to the habitat in the region.

Construction of transmission lines will involve only short-term commitment of land since most of the land will return to productive use soon after completion of construction.

Construction of the barge slip, intake, and discharge will require a commitment of some waterfowl habitat. Proper location of these to avoid the habitat areas as discussed in Section 4.1 will serve to minimize this commitment.

Construction activities will result in long-term commitments of aquatic habitat. Short-term losses of larval fish are expected to occur due to disturbance of habitat areas in the construction of the intake, discharge, rail access, and barge slip. Adult fish losses are expected to be minimal as they tend to avoid high turbidity areas.

Localized planktonic activity will be suppressed during construction but, due to the short generation times for the plankton, will rapidly replenish after completion of the construction activity. Therefore, the commitment of this biota which is irretrievably lost will be only that biota which is lost during the actual time of construction and that minor amount dependent upon the small amount of habitat destroyed. This is felt to be insignificant when compared to the total population in the locale due to the small area affected.

Table 4-1

Estimated Movers, School-Age Children
and Total Population Associated with Construction
Employment at the Hartsville Nuclear Plant

Year After Construction Begins	Employment		Population Increase	
	Total	Movers	School-Age	Total
1	2,100	550	350	1,300
2	3,800	1,700	1,100	3,900
3	4,900	2,400	1,600	5,600
4	5,000	2,700	1.700	6,100
5	4,300	2,300	1,500	5,200
6	2,300	950	600	2,200
7	900	200	100	400

Table 4-2

Hartsville Nuclear Plant
Estimated Housing Designated by Type
in the Project Area

Years After Start of Construction	Mobile Homes	Conventional Housing: Single Family Dwellings	Conventional Housing: Apartments	Conventional Housing: Sleeping Rooms	Total
1	210	150	40	20	420
2	650	460	130	60	1,300
3	900	640	180	80	1,800
4	1,000	700	200	100	2,000
5	900	640	180	80	1,800
6	360	250	70	40	720
7	80	50	20	10	160

Table 4-3

Hartsville Nuclear Plant
Estimated Distribution of Movers by
County and Associated Peak Housing and
Population Impacts

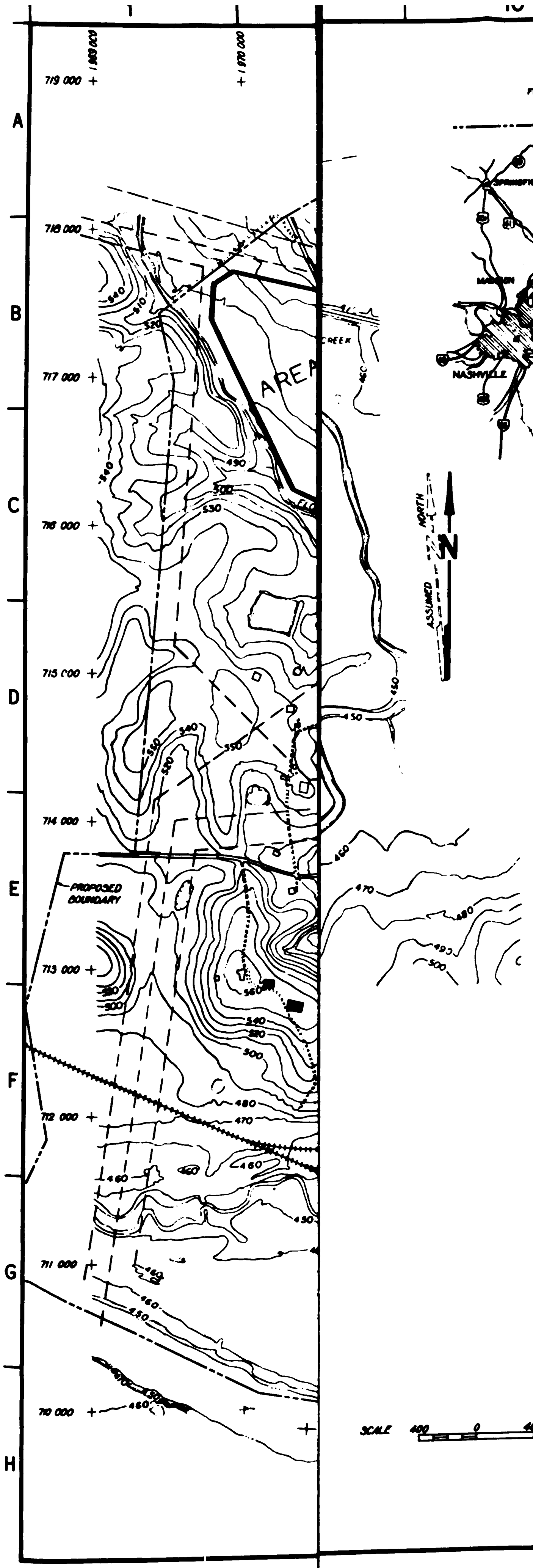
County	Percent of Movers	Housing Distribution		Population Influx	
		Mobile Homes	Conventional	School-age	Total
Trousdale	30	475	125	510	1,900
Smith	20	275	125	340	1,200
Macon	10	150	50	170	600
Sumner	20	50	350	340	1,200
Wilson	20	50	350	340	1,200
Total	100	1,000	1,000	1,700	6,100

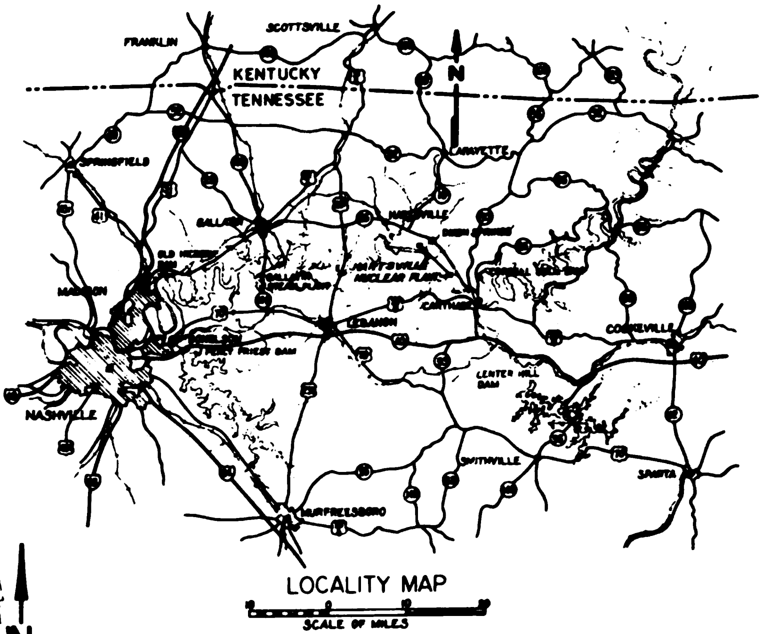
Table 4-4

Hartsville Nuclear Plant
Economic Activity During Construction

Years After Start of Construction	Annual Wages Construction Emp.*	Annual Wages Secondary Emp.**	Retail Sales**	State Sales Tax**	Local Sales Tax**
1	$13,000,000	$ 2,500,000	$ 7,000,000	$200,000	$ 68,000
2	39,000,000	7,000,000	20,300,000	600,000	196,000
3	57,200,000	10,500,000	29,800,000	875,000	288,000
4	65,000,000	11,500,000	33,500,000	980,000	323,000
5	59,800,000	10,500,000	30,300,000	900,000	297,000
6	42,900,000	8,000,000	22,600,000	660,000	218,000
7	20,800,000	4,000,000	11,200,000	330,000	109,000

*Total for project
**Five-county impact area





1. TOPOGRAPHY TAKEN FROM KELSH TWO FEET CONTOUR TOPOGRAPHY DATED 1973, AND REDUCED. CONTOUR INTERVAL SHOWN IS 10 FEET, EXCEPT AS NOTED.
2. FOR CLARITY, BUILDINGS HAVE BEEN IDENTIFIED ONLY ONCE FOR BOTH PLANTS A & B. THE BUILDINGS AND BUILDING LAYOUT FOR BOTH PLANTS ARE IN MOST PART, IDENTICAL WITH PLANT B ROTATED 180° WITH RESPECT TO PLANT A. THE OTHER BUILDINGS ARE OPPOSITE HAND (SECURITY, OFFICE, SERVICE, ETC.)
3. TENNESSEE LAMBERT COORDINATES ARE INDICATED IN THE MARGIN.
4. THE TENNESSEE LAMBERT COORDINATES FOR THE INTERSECTION OF THE N-S AND E-W BASE LINES ARE: X-1,975,420.30 AND Y-714,156.67.

Figure 4-1

CONSTRUCTION PLANT
PLANS & LAYOUTS

PRELIMINARY
CONSTRUCTION AREAS

HARTSVILLE NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF CONSTRUCTION

SUBMITTED	RECOMMENDED	APPROVED
J.L. Henson	F.A. Bowles	[illegible]

KNOXVILLE	5-31-74	89	CP	3	101W1	R0

5.1 Effects of Operation of Heat Dissipation System

5.1.1 Physical Effects of Heated Water Discharge - Four nuclear steam-electric units rated at 1,220 MW electrical (gross) each will be built at the Hartsville site. Operating at rated capacity, the thermal load which must be removed by the heat dissipation system is approximately 9,400 MW for the four units. Approximately 4,000 ft^3/s of water will circulate through the condensers from the closed-cycle cooling tower circuit. Closed-cycle natural draft cooling towers were selected as the proposed heat dissipation system, and the discharge system will utilize a multiport diffuser to disperse blowdown into the river.

Water returned to the Cumberland River will essentially be from two sources--blowdown from the condenser cooling water system and blowdown from the essential service water system. However, since the essential service water heat will be dissipated via a closed-cycle spray pond arrangement and its blowdown requirement is only about 2.2 ft^3/s, essentially all of the physical effects of heated water discharge will be a result of the blowdown from the natural draft cooling tower system.

For 4-unit operation, the blowdown from the natural draft towers will average 112 ft^3/s with a maximum of approximately 126 ft^3/s. The temperature of the blowdown may vary from 10° F. below the river temperature to 40° F. above the river temperature, depending upon the relative magnitude of the wet bulb air temperature and the river temperature.

Based upon field and laboratory model experience the multiport diffuser discharge is expected to mix completely with the fraction of the river flow passing over the diffuser sections. The dilution achieved is a function of: (1) diffuser length; (2) ratio of the river flow to the blowdown discharge; and (3) the lateral distribution of the river flow. A dilution factor of at least 10 can be achieved with the proposed design. This will be sufficient to meet presently applicable water temperature standards assuming blowdown can be held up or reduced as discussed in Section 3.4 when the river flow is less than 3,600 ft^3/s. Field studies will determine if river flows less than 3,600 ft^3/s may be sufficient to provide the necessary dilution for the blowdown discharge. The details of the diffuser pipe diameters, port size, and port spacing, will be based on future, more detailed studies.

The proposed multiport diffuser location is downstream of Dixon Island. This location would minimize impacts to fish and wildlife in the environmentally sensitive areas around Dixon Island.

The mixing zone is expected to extend 150-200 feet downstream from the diffuser and to be confined to the bottom half of the river depth where heated water leaving the mixing zone will rise vertically and spread laterally, forming a surface layer. The upstream extent and temperature distribution in this intermediate region of the plume will depend strongly upon the river flow and is not known quantitatively;

however, the temperature rise in this region will be less than the maximum rise corresponding to the dilution requirement.

The actual thermal regime induced in the Cumberland River will vary in response to changes in river flow, blowdown discharge, and blowdown temperature rise. However, the impact of the discharge on water temperature will not exceed the thermal regime described above which is based on conservative values of these parameters, i.e., maximum blowdown discharge and temperature rise and minimum river flow.

A detailed discussion of the mixing zone and expected plume characteristics is contained in the Hartsville Nuclear Plants Environmental Report.

5.1.2 Thermal Standards - Thermal standards for the reach of the Cumberland River on which the Hartsville site is located were established by the Tennessee Water Quality Control Board and approved by the Environmental Protection Agency.

Water Quality Standards - The particular thermal standard which applies at the Hartsville site states that:

> The maximum water temperature change shall not exceed 3° C. relative to an upstream control point. The temperature of the water shall not exceed 30.5° C. and the maximum rate of change shall not exceed 2° C. per hour. The temperature of recognized trout waters shall not exceed 20° C. There shall be no abnormal temperature changes that may affect aquatic life unless caused by natural conditions. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.

Water temperature measurements to determine compliance with this standard shall be made in accordance with the following definition and interpretation:

> Mixing Zone - Mixing zone refers to that section of flowing stream or impounded waters necessary for effluents to become dispersed. The mixing zone necessary in each particular case shall be defined by the Tennessee Water Quality Control Board.
>
> Insofar as practicable, the effect of treated sewage or waste discharges on the receiving waters shall be considered after they are mixed with the waters and beyond a reasonable zone of immediate effect upon the qualities of the waters. The extent to which this is practicable depends upon local conditions and the proximity and nature of other uses of the waters.

5.1.3 Biological Effects of Intake -

Fish - The cooling water intake will be located at a deep, midchannel position to minimize impingement and entrainment of fish by

avoiding rich, shallow areas around Dixon Island and the mouth of Dixon Creek.

No empirical larval fish abundance data for a complete season are yet available. Using data from Wheeler Reservoir, a larval fish concentration of 29.59 larval fish/m^3 over a 91-day period is estimated for this portion of Old Hickory Reservoir at the proposed plant location. This will result in the entrainment of approximately 16 million larval fish during this 91-day period of larval fish availability. The calculated value is probably overestimated due to the deepwater location of the intake structure at approximately reservoir elevation 422 (near the bottom of the river channel).

Mortality of entrained fish is assumed to be 100 percent because of the high temperature differential (delta t), mechanical damage due to pumping, passage through the cooling towers, and the long retention time under closed-cycle operation. Because of the depth of the intake and its location away from the shoreline overbank areas, impacts on post-larval size fishes will be minimal.

Other Aquatic Life - Since the plant will have a closed-cycle mode of cooling, all of the aquatic organisms that pass through the intake screens will be killed. The forms of aquatic life that will be affected in addition to fish include phytoplankton, zooplankton, and planktonic veligers of Asiatic clams (*Corbicula*). The amount of plankton lost will vary seasonally because of climatic variations and varying life cycles of different planktonic forms. However losses of planktonic forms in cooling water can be assumed to be proportional to the total intake flow. Phytoplankton losses should be made up within a few days and zooplankton in a few weeks.

5.1.4 Biological Effects of Discharge - Heated water returned to the reservoir will be mostly from two sources - blowdown from the CCW system and blowdown from the ESW system. The heated water discharge will be mixed with the reservoir water to meet applicable thermal regulations. Aquatic organisms are expected to incur little or no deleterious effects.

5.1.5 Effects of Rate of Temperature Change of Receiving Water - Assuming a minimum flow of 3,600 ft^3/s with the proposed deepwater multiport diffusers, blowdown discharge will produce a mixing zone approximately 200 feet wide, 15 feet deep, and 150 feet long in which delta t will exceed 5.4° F.[1] The temperature gradient within the mixing zone is steep, with a maximum of 50° F. at the diffuser pipe to 5.4° F. 150 feet downstream. At a mean daily flow of 17,000 ft^3/s (0.75 ft/s), larval fish will be exposed to a delta t greater than 5.4° F. for only a few minutes. Precise effects of such a delta t for larval fish are unknown; however, the top of the mixing zone is 15 feet below the surface and covers less than 1/2 of the channel width and therefore impacts on larval fish are expected to be minimal.

Post-larval fish will probably avoid the turbulence in the immediate vicinity of the diffuser pipe. Some fish may selectively

position themselves in the heated waters at the lower end of the mixing zone and in the heated plume below because of temperature preferences and the availablility of plankton and larval fish killed during passage through the condensers. Sudden cessation of heated discharges could induce thermal shock in these fish. However, this should have no significant influence on the total reservoir fishery.

Under normal operating conditions, refueling of each nuclear unit will occur every 12 months, with only one unit shut down at any one time for refueling. This would cause a 25-percent reduction of heat discharge. The multiple units should reduce the possibility of a sudden cessation of heat discharge because of the units going down.

Since current temperature regimes of the Cumberland River in the Hartsville area are lower than usually encountered in warm water fisheries, projected temperature increases may have a beneficial effect by increasing the productivity of fish and other warm water aquatic organisms.

Some shifts in relative abundance of fish species may occur. Since the mixing zone occupies less than one-half the channel width and depth, no barrier to migration is expected in that area.

5.1.6 Fog and Ice - The evaluation of the plume lengths for the natural draft wet cooling towers was based on a TVA model developed from observations of plumes from the natural draft towers at the TVA Paradise Steam Plant in Kentucky and from meteorological data from the Paradise meteorological station and the National Weather Service (NWS) rawinsonde station near Nashville, Tennessee. This plume length model has been used to evaluate the potential plume lengths for cooling tower alternatives at the TVA Browns Ferry, Sequoyah, Watts Bar, and Bellefonte Nuclear Plant sites.

The Paradise plume length model was adjusted to account for the larger evaporation rates for the Hartsville cooling towers by using Nashville NWS dew point and temperature data and the Hartsville plant maximum design evaporation rates. The natural draft cooling towers were treated as a point source of water vapor which was assumed to be near the center of the plant site. The expected plume lengths and frequency of occurrence by sector for natural draft cooling towers are shown in figures 5-1 and 5-2.

Average daily traffic volume data for 1972 for roads in Macon, Smith, Trousdale, and Wilson Counties in Tennessee were used in estimating the number of vehicles per year that might be affected by fogging and icing from the operation of the cooling facilities.[2]

River fogging from the heated water discharge associated with blowdown was analyzed. River water temperature data, wind speed, dry-bulb temperature, and relative humidity data, collected at the TVA Gallatin Steam Plant, were used in a modified empirical model developed for the Green River at the Paradise Steam Plant for estimating the occurrence of river steam fogging. Hourly or diurnal data for flow

rates in Old Hickory Reservoir were not available. Therefore, the maximum temperature rise (5° F.) and minimum river flow were applied to the fogging model giving a calculated number of hours (497) of river fogging which is conservative. This number is exclusive of the 17 days per year that fogging occurs naturally.[3]

Rime icing associated with the plumes or steam fog is not expected to present any problem from operation of natural draft cooling towers.

Drift from the cooling towers will be kept to a minimum by drift eliminators and probably would not reach the ground or other surfaces beyond 2,000 feet from the towers.[4,5] Accumulation of glaze ice will be limited to structures within a few hundred feet of the towers; however, few, if any, drift droplets reach the ground.

Ground Transportation - Observations at the TVA Paradise Steam Plant as well as observations by other researchers[6] show that natural draft plumes usually evaporate before reaching ground level in areas of relatively flat or gently rolling terrain. Therefore, no significant effects on ground transportation are expected due to plumes or rime icing.

Water Transportation - Because of the relatively high-level releases from the natural draft towers, river traffic would not be affected by the plumes. Steam fogging from blowdown discharge into Old Hickory Reservoir could affect river traffic about 497 hours annually. Effects would be most pronounced over the river immediately downstream from the plant site in the area of the maximum river surface temperature rises due to the blowdown discharge.

Air Transportation - Analysis of the predicted natural draft tower visible plume behavior shows that maximum plume lengths should be about 9 miles. Since no airports are located within 10 miles of the Hartsville site, no interference with airport operation is expected.

5.1.7 Other Impacts

5.1.7.1 Cooling Tower Drift - Terrestrial plant and animal life within the influences of cooling tower plumes may be affected by changes in moisture and chemical regimes from drift. Little is known regarding moisture and chemical effects related to drift although several drift salt effect analyses have been attempted.[7,8,9] Data and results from these studies are not easily applied locally. Chemicals transported in drift water droplets will consist of those that are in the river water plus those added in the cooling system. The overall chemical load should be alkaline, consisting primarily of carbonates and sulfates. Changes in plant growth rates, species diversity, disease, parasite infestations, and other problems could be postulated as resulting from moisture alterations. These changes would probably be subtle, long-term, and extremely difficult to detect.

5.1.7.2 Elevated Structures - Tall stacks, natural draft cooling towers, or other high structures could have adverse effects on migrating songbirds, and waterfowl. Several studies, including two at TVA plants, are underway to determine the extent of impacts on birds caused by elevated structures. At TVA's Paradise plant, three tall stacks (over 700 feet) and three natural draft cooling towers are being monitored. Also, an 800-foot stack at TVA's Bull Run plant is being monitored. Data gathered for several years at the Lake Erie Davis-Besse site indicate these effects are minimal.[10] Preliminary TVA data at Paradise and Bull Run also indicate minimal effects.

5.2 Radiological Impact on Biota Other Than Man

5.2.1 Exposure Pathways - Exposure pathways for organisms other than man originate with either liquid or gaseous effluent releases and result in doses from external and internal routes. External pathways include submersion in air and water and exposure to soil and sediment. Internal exposure results from the ingestion of food or water and the inhalation of air. The primary exposure pathways are shown in figure 5-3.

5.2.2 Radioactivity in the Environment - Analyses for the following representative organisms and pathways are performed to determine the potential radiological impact of the Hartsville Nuclear Plant.

Aquatic Organisms	- external exposure from water
	- external exposure from sediment
	- internal exposure
Terrestrial Vertebrates	- external exposure from air
	- external exposure from ground or water
	- external exposure from direct radiation
	- internal exposure from ingestion or inhalation
Terrestrial Plants	- external exposure from air
	- external exposure from ground
	- external exposure from direct radiation

Because of the complexity of biological functions and the interrelationships between organisms and their environment, simplified dose models have been developed to predict doses resulting from the more significant exposure pathways. Conservative assumptions are chosen because these models cannot predict the detailed variances of a system and because the results of an analysis cannot be applied equally to all members of a population.

A detailed discussion of the exact assumptions, equations, and models used is given in Section 5.2 of the Environmental Report.

For liquid effluents the assumption is made that aquatic biota are exposed to radionuclide concentrations in the river near the liquid

effluent diffusers. Using flow data for the Cumberland River measured during 1922-71, dilution in the river near the nuclear plant is calculated using an average flow of 17,600 ft^3/s and mixing with one-half the riverflow. The resulting average annual concentrations of radionuclides are listed in Table 5-1. For comparison purposes, average annual radionuclide concentrations in the plant effluent prior to mixing in the Cumberland River are also listed.

Terrestrial Vertebrates - In general, aquatic plants such as green algae concentrate trace elements to a greater extent than do fish and invertebrates.[11] Therefore, maximum potential internal dose estimates for terrestrial vertebrates are computed for ducks and muskrats with diets consisting entirely of green algae from algal masses growing near the water discharge structures.

The duck and muskrat are assumed to have a mass of 1,000 g, an effective radius of 10 cm, and a daily intake of 333 g of green algae. Long-lived radionuclides such as Cs-137 can deliver significant portions of the total dose commitment long after the time of ingestion. Therefore, a life span of five years is assumed. In the absence of data applicable specifically to ducks and muskrats, ICRP data[12] are used for the fractional uptake and for the biological half-life of parent radionuclides. The use of human data for biological half-lives is considered to be conservative because warm-blooded vertebrates smaller than man exhibit more rapid elimination rates.[13]

The duck and muskrat are assumed to be exposed continuously by full immersion in the water.

Aquatic Plants, Invertebrates, and Fish - Radioactivity deposited internally in these organisms is estimated by multiplying the average water concentration in the Cumberland River near the point of discharge by the applicable concentration factors[11,13,14] listed in Table 5-2. Doses are estimated for organisms having effective radii of 3 cm and 30 cm. In the absence of detailed knowledge of the dynamic behavior of radioactive daughter products that are produced internally, all daughter products are assumed to be bound permanently in the organisms; and every daughter in a decay chain is assumed to decay at an equilibrium disintegration rate equal to the disintegration rate of the parent nuclide.

Benthic organisms such as mussels, worms, and fish eggs receive additional external doses from radioactivity associated with bottom sediments. Accurate prediction of the accumulation of radioactivity in sediment and the resultant doses to benthic organisms requires detailed knowledge of a number of factors, including mineralogy, particle size, exchangeable calcium in the sediment, channel geometry, waterflow patterns, chemical form of the radiocompounds, and behavioral characteristics of the organisms. In the absence of this detailed knowledge, external doses from radioactivity associated with bottom sediment are calculated assuming a 4-π geometry for beta doses and a 2-π geometry for gamma doses. This method is described in Appendix I1 of the environmental report.

In the evaluation of the potential impact of gaseous effluents on terrestrial organisms, biota are assumed to be located near the site boundary in the WSW sector, where the maximum average annual radionuclide concentrations in the air and on the ground are predicted. Table 5-3 gives concentrations of gaseous effluents at the plant boundary.

A cow is assumed to be located on the nearest grazable land in the sector having the maximum average annual radioiodine concentration. A cow's thyroid dose is calculated from the inhalation and grass ingestion exposure pathways.

External doses to terrestrial organisms from air submersion and ground contamination are estimated using dose factors derived for humans. It is assumed that total body dose factors for humans are applicable to terrestrial vertebrates and that skin dose factors for humans are applicable to terrestrial plants and small fauna. An additional component of external radiation exposure due to direct radiation from the nuclear plant is also calculated.

5.2.3 Dose Estimates - Dose estimates for aquatic plants, aquatic invertebrates, and fish are listed in Table 5-4. Estimates for terrestrial organisms are listed in Table 5-5. These estimated doses for biota are below the dose limits established for occupational workers in the nuclear industry.[15,16] In the "BEIR" report,[17] it is stated that " . . . probably no other living organisms are very much more radio-sensitive than man, so that if man as an individual is protected, then other organisms as populations would be most unlikely to suffer harm."

5.3 Radiological Impact on Man

5.3.1 Exposure Pathways - Extensive waste treatment systems included in the Hartsville Nuclear Plant design will assure that the lowest practicable amounts of radioactivity will be released to the environs during normal operation of the plant. However, these releases will result in small exposures to individuals from both external and internal sources. The most significant exposure pathways are diagrammed in figure 5-4.

Radiation exposures from liquid effluents generally arise from recreational activities or diet. External exposures occur as a result of swimming, boating, and fishing in waters containing radioactivity; and persons involved in shoreline activities may be exposed from radionuclides accumulated in sediment. These external doses are proportional to radionuclide concentrations in water and sediment. Internal doses result from ingestion of water, ingestion of fish and other aquatic organisms that contain radionuclides, and ingestion of water-fowl which feed on aquatic organisms. Swimmers receive an internal dose from tritium accumulated in the body as a result of exchange processes.

Individuals exposed to gaseous effluents receive external radiation doses which are dependent upon the duration of exposure and the concentrations of radionuclides in air. An additional source of external

exposure, generally of minimal significance, is attributable to radionuclides deposited on the ground. Internal doses result from inhalation, ingestion, and tritium transpiration. The magnitude of these doses is a function of the radionuclide concentrations in air and the physical and chemical forms of the radioactivity. Internal doses result from ingestion because airborne radionuclides deposited on land areas can be retained on or translocated to edible parts of vegetation. More complex food chains, in which radionuclides ingested by animals are transferred to tissues or animal products subsequently ingested by man, are also potential routes of internal exposure. An important example of such a food chain is the pasture-cow-milk-man pathway. Ingestion doses are functions of radionuclide concentrations on vegetation, transfer coefficients, and dietary habits.

In addition to doses from radioactivity released in liquid and gaseous effluents, external doses result from direct radiation from turbines, steam lines and other equipment in the turbine building and from condensate storage tanks. These doses are functions primarily of the relative geometry between the plant components and the exposed individuals. Radiation exposures also occur during the transportation of radioactive materials to and from the plant. The radiological impact upon the exposed populace is a function of the external radiation levels around the packaging, transportation routes, frequency of shipments, and geometry.

5.3.2 Liquid Effluents - Estimated average annual activities of radionuclides released in liquid effluents are listed in Section 3.5. Data listed in Table 5-6 for public and industrial water supply systems are used to calculate dose commitments from the ingestion of Cumberland River water. Dilution of the radionuclide concentrations in the Cumberland River is calculated using flow data measured during 1922-71. The plant effluent is assumed to be mixed with one-half of the river flow in the 6.4-mile reach between the nuclear plant and the first public water supply intake. Although natural water turbulence will continue to increase the dispersion downstream, dilution by half the river flow is assumed to be maintained for 30 miles, past which full dilution by the river flow is assumed. Radionuclide concentrations in ground water drawn within one-half mile of the river are assumed to equal the corresponding concentrations at the nearest point in the river. For comparison purposes, the maximum dose to a hypothetical individual assuming ingestion of undiluted liquid effluent is estimated to be 0.14 mrem/yr to the thyroid.

Additional assumptions and methods for the evaluation of the radiological impact from liquid effluents are described in the environmental report. Other exposure pathways include recreational use of the river and the consumption of fish and waterfowl which have lived in the vicinity of the plant discharge. Dose estimates for an adult from all pathways considered are summarized in Table 5.7.

5.3.3 Gaseous Effluents - Estimated activities of radionuclides released to the atmosphere in gaseous effluents are listed in Section 3.5. Details of the calculations for atmospheric transport and diffusion, ground contamination, and exposure pathway analyses can be found

in the environmental report. All dose calculations are performed using the average annual meteorological joint frequency distribution given in Section 2.6.

Dose estimates for an adult are summarized in Table 5-8. The maximum dose to the thyroid of a one-year-old child from the consumption of milk produced by a hypothetical cow grazing on the potential pasture predicted to have the highest average annual iodine concentrations is calculated to be 12 mrem per year. This radiation dose estimate is treated as a special case, and the calculations are discussed in detail in Appendix I2 of the environmental report.

5.3.4 Direct Radiation

5.3.4.1 Radiation From Facility - The annual individual and population doses due to direct radiation from the four condensate storage tanks (CST) and the air-scattered N-16 radiation from the four steam turbine systems are summarized in this section. In calculating annual doses from radioactive material contained in the condensate storage tanks, the collimating and shielding effects of the terrain and of the buildings surrounding the tanks are considered. Doses at the site boundary and at structures within two miles of the plant are reported only if these locations are in direct "view" of one or more of the condensate storage tanks. Since the doses computed for N-16 contained in steam turbine systems result from overhead air scattering of N-16 gamma radiation, N-16 doses are calculated at the site boundary for all sectors and at all structures. In computing population doses, persons located beyond two miles from the plant are not considered because of the low doses which are calculated at two miles and because of the further rapid reduction of these low doses with distance.

TVA has determined that there are no hospitals or schools within two miles of the plant. All persons considered in these calculations are located at private residences (structures). The locations of structures and their spatial relationships to the condensate storage tanks and N-16 sources, the population at each structure, the mathematical models, and the source terms used in these calculations are described in detail in the environmental report.

The maximum annual individual doses at the HNP site boundary and at the structures considered in these calculations are listed in Table 5-9. These maximum doses occur in different directions from the plant.

5.3.4.2 Radiation From Transportation of Radioactive Materials

5.3.4.2.1 New Fuel - TVA has contracted with the General Electric Company to fabricate the fuel for the Hartsville reactors. The fuel will most likely be manufactured at General Electric's facilities at Wilmington, North Carolina. Shipment will probably be by truck. Shipment from Wilmington, North Carolina, would cover approximately 600 miles.

New fuel could be shipped by rail or truck. The gross loaded weight of a shipping container with two fuel assemblies is about 2,700 pounds. A shipment involving 16 containers would weigh approximately 43,200 pounds. The initial core for each unit will require approximately 23 shipments.

The levels of radiation that are emitted from unirradiated new fuel assemblies are relatively low. Due to the type of radiation emitted and the self shielding of the fuel itself, no additional gamma or beta shielding is required for shipping packages for new fuel. The radiological impact on the environment is minimal since the new fuel contains no radioactive fission products either gaseous or solid, the fuel has a high melting point, the fuel is clad with a high-melting-point, high-strength material (Zircaloy), the fuel is in the form of an insoluble solid, and the fuel assemblies are expected to remain stable under all postulated thermal conditions.

Considering the above facts, it is concluded that there are no environmental risks from radiation associated with the normal shipment of new fuel.

5.3.4.2.2 Spent Fuel - Irradiated fuel will be shipped offsite to a reprocessing plant where usable materials such as fissionable uranium and plutonium will be recovered. The major portion of this radioactivity is tightly held within the insoluble, high-melting-point UO_2 pellets. Therefore, there exists no ready mechanism for dispersing any substantial fraction of the total contained radioactivity. Prior to offsite shipment, the fuel will be allowed to decay radioactively for about three to four months. All noble gases with the exception of krypton-85 will have decayed to insignificant levels and iodine-131 will have decayed to low levels. Also, the rate of decay heat generation will have decreased substantially.

There are several possible methods for shipping irradiated fuel. These range from truck shipments with cask capacities of from 2 to 6 fuel assemblies to rail shipments with cask capacities of from 8 to 32 fuel assemblies. Water transportation of spent fuel could also be used.

Truck shipments of the 800 spent fuel assemblies per year from the site would require about 400 legal weight shipments (73,280 pounds) or about 135 shipments if overweight truck loads are permitted. Rail shipments originating from the plant would require from 25 to 45 shipments annually depending upon the size of the casks used. The 18 and 32 assembly casks, when fully loaded, will weigh 168,000 pounds and 230,000 pounds respectively.

The main environmental effect from the normal shipment of spent fuel would be the potential direct radiation dose from the fuel as it passes along its route from the plant site to the reprocessing facility. Making the conservative assumption that shipments are made with the maximum amount of radioactivity allowable, the maximum dose

to any individual along the route from normal shipment would be about .006 mrem/y or about .004 percent of the dose from natural background radiation.

5.3.4.2.3 Radioactive Waste - Radioactive waste materials to be shipped from the plant will include spent demineralizer resins, both powdered and bead type, used filters, waste sludges and evaporator bottoms resulting from radwaste processing systems, and miscellaneous dry solids.

The spent powdered resins and spent bead resin will be placed in 170 ft^3 steel containers and solidified with cement. Waste sludge and waste evaporator bottoms will also be mixed and solidified in 170 ft^3 steel containers and enclosed in a shielded cask. Miscellaneous dry solids will be compacted in 55-gallon drums. Spent air filters normally will be low specific activity materials and, as such, placed in boxes or other suitable packages.

If the spent air filters are too contaminated for normal packages, they will be placed in shielded packages. All shipping packages and activity levels will conform to applicable Department of Transportation and Atomic Energy Commission regulations. Table 5-10 lists the types of wastes and the estimated weight, volume, and specific activity to be shipped each year from the 4-unit plant.

The spent powdered resin, the spent bead resin, sludge, and evaporator bottoms will be placed in 170-cubic-foot containers. The number of shipments are shown in Table 5-11. Compacted waste in 55-gallon drums and air filters in boxes will be shipped in closed truck trailers shielded if necessary.

As stated for the case of spent fuel, the principal environmental effect, albeit small, of radwaste shipment is the potential radiation dose due to direct radiation from the shipment as it moves along the route. If it is assumed that shipments are made at the highest allowed radiation level, the resulting maximum dose to an individual residing at the edge of the route is about .086 mrem per year and the average is about .005 mrem/year if 542 shipments of evaporator bottoms and spent demineralizer resins are assumed. Other wastes will not contribute significantly to transportation doses. The above dose estimate represents .032 and .002 percent of the expected natural background dose respectively. Therefore, the expected environmental impact of normal radwaste shipment is not considered significant.

5.3.5 Summary of Annual Radiation Doses - TVA has estimated the radiological impact to regional population groups in the year 2020 from the normal operation of the Hartsville Nuclear Plant. Table 5-12 summarizes these population doses (man-rem/y) attributable to the following sources:

1. Exposure pathways related to the Cumberland River.
2. Exposure pathways related to the atmosphere.
3. Direct radiation from the nuclear plant.
4. Direct radiation from the transportation of radioactive materials.

5.3.6 Evaluation of Radiological Impact - Potential individual doses estimated for liquid and gaseous exposure pathways are listed in Table 5-7 and Table 5-8. The magnitudes of the doses are within the variations in natural background doses received by different individuals because of local differences in the concentrations of terrestrial radioactivity and variations in doses within different types of buildings. Additional variations in the natural background doses within the United States can be attributed to elevation and geomagnetic latitude so that doses to the total body range from approximately 100 mrem to 250 mrem per year.

The annual total body dose from effluent pathways to a population of 1,900,000 persons expected to live within a 50-mile radius of the Hartsville site in the year 2020 is calculated to be approximately 9 man-rem. By comparison, the same population will receive approximately 270,000[a] man-rem annually as a result of the average natural background dose rate[16] of 140 mrem/y to an individual in the vicinity of the Hartsville site.

TVA concludes that the normal operation of the Hartsville nuclear Plant will present minimal risk to the health and safety of the public.

5.4 Effects of Nonradioactive Chemical Discharges

All liquid discharges, with the exception of the yard drainage, will be routed through the plant discharge system as discussed in Section 3.4.3. Discharges will be mixed with the reservoir by the deepwater multiport diffuser. This diffuser will be sized to provide a minimum mixing of the discharge with nine equal parts of reservoir water. This dilution factor of ten is based on the minimum discharge of 3,600 cfs from the upstream dam which corresponds to operation of one turbine at Cordell Hull Dam. This system is designed (1) to provide good diffusion and mixing with the reservoir and (2) to minimize environmental effects due to disturbance of aquatic life during construction and operation of the plant.

As described in Section 2.5, there will occur periods of low or no flow in the reservoir past the plant site. These periods will be relatively short in duration, but during these periods, there may be insufficient flow to provide dilution sufficient to meet applicable water quality standards. During these periods, discharge from the plant can be held up or reduced, if required, to meet these standards.

5.4.1 Liquid Discharges via Plant Discharge Diffuser - Waste streams discharging via the plant discharge diffuser include the CCW cooling tower blowdown, the ESW system blowdown, sanitary waste systems, auxiliary steam generator blowdown, and makeup water plant demineralizer wastes. Discharges from each of those sources are discussed individually below. In addition, expected maximum concentrations in the discharge, maximum concentrations in the reservoir after initial jet mixing, typical concentration of solids in Old Hickory Reservoir, and applicable water quality criteria and guidelines are shown in Table 5-13.

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a. 1,900,000 persons x 0.14 rem = 270,000 man-rem.

The discharge values are less than the effluent guides in all cases. Some stream guidelines are, however, exceeded for concentrations of trace metals in the reservoir after mixing, but all such cases are calculated to occur only when the initial river concentration before addition of the discharge already exceeds the stream guidelines.

It can be seen from Table 5-13 that upon mixing with the reservoir, Tennessee state guidelines would be exceeded for total phosphate, total iron, manganese, aluminum, and potassium. Because the plant primarily only returns those elements to the reservoir which were taken in with the makeup, the plant will only affect concentrations in the reservoir by the concentration effect due to evaporation losses in the plant. These losses are less than one percent of the average total flow. The concentration will therefore be increased by a similar factor after total mixing in the reservoir.

In regard to the concentrations of trace metals calculated, no distinction has been made of element state or form. For conservatism, it is considered that all forms are available to the biota. In actuality, this is not true as discriminatory limits are determined by the state or form of the element as presented to an organism.

5.4.1.1 Cooling Water Blowdown - The blowdown from the main condenser cooling water systems will be the major discharge from the proposed plant. This discharge is discussed in Section 3.6. These systems will normally be operated with a concentration of solids in the system about twice that found in the reservoir and are not expected to exceed 6.6 times the concentration even under the most adverse reservoir flow conditions and the corresponding blowdown holdup periods.

There are no planned uses of any materials that would result in normal discharge of "added" trace metals to the aquatic environment.

As discussed in Chapter 3, only biocides will be added to the cooling water systems. This will result in slight additional amounts of chlorides in the blowdown stream other than that brought in from the reservoir and possibly undetectable amounts of acrolein.

Chlorine residual in the discharge will be monitored, to assure that applicable limits are met.

If acrolein were fed to the raw cooling water system, it would be diluted by a factor of about 10 upon mixing with the main condenser cooling water assuming that all of the raw cooling water systems were treated with acrolein simultaneously. Taking no credit for the natural acrolein demand of the raw water or of the systems, this would result in a concentration of less than 0.03 mg/l in condenser cooling water systems and less than 0.003 mg/l at the edge of the mixing zone in the reservoir as a result of the CCW blowdown after discharge through the diffuser. The 96-hour TLM for fathead minnows is reported[19] to be 0.06 mg/l; for juvenile minnows the 48-hour TLM[20] is 0.24 mg/l. The maximum concentration from dilution alone would be less than 5 percent of the 96-hour TLM for the fathead minnows.

The maximum doses discussed above would only result if blowdown were discharged during periods of treatment. It is anticipated that blowdown will be shut off during feed periods and will not be reinstated until some time after feed periods have terminated. The concentration in the cooling system will therefore be much less than even those discussed above due to the natural demands of the system and the scrubbing action of the tower fill. In addition, it is expected that even if slight amounts of acrolein or chlorine were discharged, the expected concentration discussed previously would be less than the natural demand of the reservoir water in the mixing zone. Therefore any residual would be reduced to insignificant levels within the initial mixing zone and would not result in significant impact on the reservoir.

5.4.1.2 Essential Service Water System Blowdown - Blowdown from the closed cycle ESW system will be discharged along with the blowdown from the main condenser cooling water system. In general, the discharges from the ESW through blowdown are of the same nature as those discussed for the main condenser cooling water system.

On the average, the concentration of solids in the ESW blowdown will be about twice that of the makeup water. The relatively small volume of the ESW blowdown will not affect concentrations in the reservoir to any significant degree. Biocides released from the ESW system via blowdown would be diluted approximately 30 to 1 upon mixing with the cooling tower blowdown, thus reducing their concentrations to insignificant levels. As discussed before, this would not be treated concurrently with other raw water systems so there would not be any additive effects.

5.4.1.3 Filtered Water Treatment System - The neutralized spent regenerants from the makeup demineralizer will be mixed with the condenser cooling water and discharged via the condenser cooling water blowdown as discussed previously. The discharge concentrations shown in Table 5-14 show that the daily concentrations of these minerals discharged from the plant would be small compared to the natural concentrations present in the reservoir.

5.4.1.4 Auxiliary Boiler Blowdown - As discussed in Section 3.6.6, the blowdown from the auxiliary boilers will contain approximately a 0.3 mg/l concentration of ammonia and a very small amount of solids. It is expected that by routing this blowdown to the condenser cooling water systems cooling towers, the ammonia concentration would be removed due to the aeration effects of the towers. The contribution to discharge concentrations due to eventual discharge of this blowdown via the condenser cooling water system would be minimal.

Even if the blowdown were to be discharged directly via the condenser cooling tower blowdown, the dilution of greater than 3,000 would reduce the ammonia concentration to less than 0.1 mg/l which is far below any identified harmful concentrations. In any case, it is felt that due to the quality and size, this blowdown stream would have no detectable impact upon the environment.

In addition to the treatment chemicals contained in auxiliary steam generator blowdown, other impurities will be present in small quantities. These are primarily natural elements which entered the system in small quantities through the makeup and were concentrated by generation of the steam. This would not be "added" compounds. There would be some "addition" of corrosion products to the stream but these oxides primarily would be in very small concentrations.

5.4.1.5 Sanitary Wastes - The treatment the sanitary wastes will receive was described in Section 3.6.9. The effluent from this treatment plant will be a chlorinated stream meeting the applicable requirements of the Tennessee Pollution Control Board. The expected total discharge of sanitary waste pollutants from each plant is as follows:

	Pounds/day	Δ Concentration in Blowdown
Suspended Solids	16.80	0.06 ppm
Dissolved Solids	29.90	0.10 ppm
BOD, 5 Day 20° C.	2.61	
Phosphate (Soluble)	1.07	8.70 ppb
Chlorine	0.49	1.60 ppb

As can be seen, the concentrations of these materials are insignificant when compared with the natural levels of those present in the reservoir (Section 2.5). Both plants will be operated to ensure that any untreated wastes will not be discharged to the reservoir. It is therefore expected that there will be no significant adverse effects on the environment because of the discharge from the sanitary waste treatment plant.

5.4.1.6 Various Plant Systems - As discussed in Section 3.6.6 and Section 3.6.8, various systems within the plant are treated chemically for corrosion control and other reasons. The potential any of these systems would have for discharging pollutants to the environment would be either through leakage or being drained for maintenance. In either case, the waste from these systems would be contained inside the building sumps or other storage facilities. These wastes would then be treated in the radwaste system by filtration, demineralization, or evaporation. After treatment, the treated water would be recycled if possible and the waste disposed of as solidified waste. If the water is not suitable for recycle, it would be discharged only after it had been analytically tested to ensure it did not contain any harmful substances. It is not expected that any discharge of pollutants would occur from these sources.

5.4.2 Discharge via Yard Drainage - Chemicals within the yard area will generally be contained in the immediate area of their use by dikes, basins, etc., and reclaimed. In the unlikely event the material were to escape the containment, it would flow to the yard drainage pond where it would be detected by routine surveillance. It would be contained in the pond until reclaimed or adequately treated. No additives will be routinely discharged via the yard drainage system.

Oil and lubricants used in transformers and electrical equipment were discussed in Section 3.6.7. The plant design is such that in the event any of these compounds leaked from their equipment or storage facilities, they would still be contained. Leakage inside the buildings would flow to the building sump where it would be contained and recovered for reclamation or disposal. Leakage of materials in the switchyard or storage areas will be contained within diked areas and basins provided for this where they could be recovered.

In the event these materials were to escape from the sumps and basins, they would flow to the yard drainage pond. The yard drainage pond is designed so that the oil could not escape from the pond, but would be retained for recovery.

5.4.3 Solid Waste Disposal - Nonradioactive solid wastes from the plant will be disposed of in an approved landfill as described in Section 3.6.12. This is a common method practiced by industry and municipalities and has been shown to be environmentally acceptable.

The sludge from the flocculation and filter process will be dewatered and disposed of as solid waste by burial in an approved landfill. Burial is a commonly accepted method of disposal for this type waste and is used by municipal and industrial plants and environmental impacts from this method of disposal would be minimal.

5.4.4 Cooling Tower Drift - Droplets of water carried out of the tower as drift will contain the same concentrations of solids, etc., discussed in Section 3.6. Some of these droplets will evaporate leaving the solids as a dust-like residue to be dispersed to the environment. Large droplets not evaporated will deposit on the immediate area around the tower. Studies by Stewart[4] and Hosler, et al[5] indicate that the majority of drift particles fall out within 2,000 feet of the cooling tower under normal conditions. Approximately 484 pounds of solids per day at full operation will be carried out of the towers as drift. These solids will primarily be those taken from the reservoir.

Current state of the art is insufficient to accurately predict the deposition patterns of the drift and assess its impacts. However, natural draft cooling towers have been used at TVA's Paradise Steam Plant for several years. Observations at Paradise have not identified any significant impacts on the surrounding environment resulting from drift from the towers. After discussing the possible environmental effects of solids from drift for fresh water cooling towers with other investigators,[21] TVA has determined that there will be no significant adverse environmental impacts due to the deposition of solids in the form of drift from the operation of the Hartsville cooling towers.

5.4.5 Gaseous Emissions - Emissions from the auxiliary steam generators are shown in Section 3.6.13, as well as the maximum expected ambient pollutant surface concentrations from these sources and the applicable ambient standards. It is evident that these emissions from these sources will result in a small fraction of the applicable guides and will, therefore, be of negligible environmental impact. Diesel generators, when operated, produce gaseous emissions. However, the diesel generators are operated so infrequently that the impact is insignificant.

Detergent wastes will be evaporated and not discharged to the waterways. Although the detergent wastes constitute a small portion of the plant discharges, the detergents present are potentially environmentally detrimental to the quality of water in the Old Hickory Reservoir. By evaporating these wastes, a small amount of water vapor will be discharged to the air, but the solids will be disposed as solid radwaste --thereby minimizing the environmental impact. Adverse effects are not expected from the small discharge of water vapor.

5.5 Effects of Operation and Maintenance of Transmission Lines

No significant adverse environmental impact is expected to occur during normal operation of the 500-kV transmission lines. Occasionally a light humming may be audible directly under the 500-kV lines, but this noise should rarely be heard off the right of way. Transmission lines can cause mild static charges to develop on some types of fencing and other ungrounded objects under the lines. These charges are similar to the common static charges people experience when walking on certain types of indoor carpeting in dry weather.

For the transmission line rights of way, property owners retain all mineral rights to their land and may use the land for whatever purposes desired so long as such uses do not conflict with the terms of the easement. In most instances the existing land uses may continue. However, buildings, signboards, stored personal property, or other obstructions which create fire hazards and/or interfere with the operation and maintenance of the line may not be located on the rights of way.

Vegetation must be controlled so it will not interfere with the safe and reliable operation of the line. Growth of vegetation will be controlled by mechanical or hand cutting and limited use of herbicides. In wooded areas brush mowing (bushhogging) will be combined with hand- or power-saw felling of larger timber. For heavier stands, dozer-blade clearing will be employed, and a brush rake will be used to windrow the felled brush along the edge of the right of way. Vegetation will not be removed where there is no danger of trees interfering with line operation.

5.5.1 The "Edge Effect"[22,23], Wildlife Benefits and Impacts - Operation of the proposed lines should have no significant impact on wildlife, but maintenance activities will cause periodic changes in animal communities by removal of woody vegetation every 3 to 5 years. These maintenance clearing activities will cause changes in bird, mammal, reptile,

and amphibian populations. TVA is presently in the process of establishing research projects which will enable quantification of the changes due to power line construction and maintenance activities.

Early stages of plant succession on cleared rights of way, particularly the first 6 to 8 years, are the most productive for many wildlife food and cover plants. In addition, the low herbaceous plant growth supports insects which provide the high protein content necessary in the diet of many young vertebrates (game and nongame).

Power line rights of way have potential as habitat for certain species because of the "edge effect" that results where low herbaceous and woody plant growth meets the forest or where adjacent cropland and weedy or "brushy" rights of way merge. In many cases the number and density of some species is greater in the edge than in the vegetation communities adjacent to it.

A common wildlife management practice in large sections of unbroken forest land is to develop relatively small, evenly spaced clearings. Power line rights of way create linear forest openings. The sunlight penetrating the forest edge through the rights of way stimulates understory growth adjacent to the power line. Periodic power line maintenance then perpetuates these habitat conditions. Specific management practices geared toward wildlife production can significantly enhance the wildlife potential already present along transmission lines. TVA attempts to implement such management practices jointly with the agency controlling public lands crossed and with the landowner on private lands when consistent with his own land use desires. In such cooperative undertakings, rights of way in wooded areas are planted to grasses or low-growing vegetation except along the outer edges where taller growing plants such as autumn olive may be used. Maintenance is then geared to the continuation of this type plant community.

TVA, in cooperation with the Tennessee Game and Fish Commission, now named the Tennessee Wildlife Resources Agency, has published a booklet for distribution to landowners within the service area describing practices they can employ to benefit various wildlife species on rights of way.[24]

Old Hickory Reservoir (Cumberland River) which seasonally attracts substantial numbers of waterfowl, is traversed by the proposed transmission line corridors. It is expected that some waterfowl will collide with the lines resulting in their injury or death.

5.5.2 Chemical Maintenance of Right of Way - A special problem on the proposed rights of way is the growth of vegetation because of the relatively long growing season in central Tennessee. It will be controlled by mechanical or hand cutting and the limited application of herbicides. During the fiscal year ending June 30, 1971, a transition was made in TVA's right of way maintenance program from essentially complete herbicidal control to primarily mechanical maintenance. Chemical maintenance is now limited to those areas which are both remote and inaccessible. For the transmission line corridors connecting the Hartsville

Nuclear Plant, the need for chemicals in the maintenance program for these corridors is not anticipated.

However, when herbicides are used, their application is carefully controlled to ensure on-target placement and avoid drift off the right of way or contamination of watercourses. Watercourses are identified by ground or air reconnaissance prior to spraying, and no chemicals are applied within 100 feet of these areas. The herbicides used for aerial application are Tandex and Tordon 101; for hand applications Tordon 10K pellets are used, all of which are approved for this use by the Federal Working Group on Pest Management (FWG on PM). From transmission line right of way inspections, TVA determines each year where chemical control of brush is to be used, the chemicals to be employed, and the method and rate of applications. The entire annual program is then submitted to the FWG on PM for their review.

In addition to information about program objectives, chemicals used, and mode of application, the program annual report summarized precautions taken by TVA in applying the chemicals and specifies areas of the environment that are to be avoided or treated with caution. Field observations have revealed no significant adverse environmental effects from the use of chemicals in the right of way maintenance program.

TVA employees responsible for right of way maintenance work closely with TVA wildlife biologists and foresters. The combined expertise of these TVA specialists ensures that biologically sound and economically feasible recommendations are made to improve wildlife habitat on the rights of way.

A detailed report of TVA's program for chemical treatment of transmission line rights of way as submitted to the Federal Working Group for calendar year 1974 can be found in Appendix L2 of the environmental report.

5.5.3 Multiple Use of Rights of Way - As a general rule, where transmission line rights of way cross wooded areas, TVA is willing to perform the necessary clearing or invest as its part of a cooperative arrangement an amount which approximates the average cost to clear or later reclear the area as dictated by maintenance requirements. TVA negotiates with county agents, state, and Federal park commissions, soil conservation agencies, sportsmen groups, and other interested agencies that propose compatible uses for wooded land within easement areas that will meet the goals of the interested parties. Under such an arrangement, forest development techniques can be implemented which allow growing of small trees such as Christmas trees and nursery stock. Also, buckwheat, Korean and Kobe Lespedeza, and other low-growing grasses and seed crops can be planted which are beneficial to game and nongame species.

It is recognized that many additional multiple right of way uses can be identified. Agricultural uses other than the growing of timber may be continued. The easement area may be fenced and cross-fenced. Roads and driveways may be installed provided fills do not interfere

with proper clearances of the transmission line, and utilities such as water lines, telephone lines, electrical distribution lines, sewer lines, and gas lines may be installed. Stock ponds or lakes may be built provided tower foundations are not jeopardized. Lawns, flower or vegetable gardens, and other domestic uses may continue. The landowners involved may also establish playgrounds, athletic fields, golf courses, parks, picnic areas, hiking trails and horseback riding trails. In short, all multiple uses are permitted under the terms of TVA's easement other than those which would interfere with the safe operation and maintenance of the transmission line.

5.5.4 Ozone - Under some conditions, ozone may be produced in small amounts from corona discharges (ionization of the air) in the operation of transmission lines and substations, particularly at the higher voltages. Such corona discharges can result from abrasions, foreign particles, or sharp points on electrical conductors and electrical equipment.

Extensive field tests to detect ozone in the vicinity of 765-kV lines were conducted by the Battelle Memorial Institute under a variety of meteorological conditions. From these tests, it was concluded that no significant adverse effects on vegetation, animals, or humans are to be expected from levels of ozone that may be produced in this operation of transmission facilities at voltages up to 765 kV.

In view of the design and construction standards employed by TVA in building its transmission facilities, corona discharges are minimal or nonexistent. In this connection, TVA specifications require that transmission line hardware and electric equipment for operation at 500,000 volts be factory-tested to assure corona-free performance up to maximum operating voltage levels. Accordingly any ozone which could possibly be generated by the proposed transmission lines (500-kV nominal voltage) would be environmentally inconsequential and harmless to vegetation, animals, and humans.

A list of reference material and technical reports on the characteristics, sources, and effects of ozone can be found in Appendix L3 of the environmental report.

5.5.5 Compatibility With Communications Equipment - High-voltage power lines operating in close proximity to telephone and signalling equipment may produce undesirable effects on the communication circuit through inductive coupling. However, it is TVA's normal practice to send transmission line vicinity maps to railroad and telephone companies having tracks or communication lines in the general area of proposed power lines for the purpose of making inductive coordination studies. If corrective action is indicated, the problem is jointly studied and any required changes will be mutually resolved. This procedure will be followed for the transmission line connections to Hartsville Nuclear Plant. For the proposed routes, no interference problems with communication facilities are anticipated.

5.5.6 Access for Right of Way Maintenance - Existing woods roads, farm roads, county and state highways will provide adequate access for

maintenance operations, and no special maintenance access roads will be required for the transmission line connections to the Hartsville plant.

5.5.7 Impacts on Aviation - Tall towers normally are required to accommodate long spans associated with major river crossings or to provide electrical clearance over unusual topographic features or man-made objects. When these towers exceed a height of 200 feet above local terrain or invade upon air traffic patterns, a permit must be obtained from the Federal Aviation Administration prior to construction.

The proposed transmission line corridors will cross the Cumberland River in the vicinity of the Hartsville Nuclear Plant. Transmission structures in excess of 200 feet in height are not anticipated for these relatively short river crossing spans; however, should final design dictate the use of tall towers, filing for FAA permits will be made. Appropriate markings and/or warning lights will be installed on these towers.

5.6 Adverse Effects Which Cannot Be Avoided

The construction and operation of the proposed Hartsville Nuclear Plant will result in some impacts to the environment which cannot be avoided. These impacts include air and water pollution, damage to life systems, alteration of land features and use, and effects on the social and economic structure of the area. However, efforts will be made to reduce effects to insignificant levels.

Baseline data on the preexisting appearance, quality, productivity, and usage of the proposed site have been discussed in Chapter 2. Discussion and evaluation of such expected impact on the environment resulting from construction and operation of the proposed facility are given in Chapters 4 and 5. This section will summarize the adverse impacts which cannot be avoided due to construction and operation of the project and the steps taken to mitigate these effects.

5.6.1 Water Pollution - Some unavoidable impacts to waters of the Old Hickory Reservoir will occur during construction of the plant. These include some siltation as a result of grading, excavating, and dredging; discharge of small amounts of chemicals used in cleaning equipment; and discharge of the sewage treatment plant effluent.

These impacts will be minimized by the following means:

-If dredging is accomplished by a suction dredge, the spoil material will be deposited in an upland fill area to avoid excessive siltation of the reservoir.

-Berms, diversion dikes, check dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, special drains, and other control devices will be used to control surface drainage and erosion during grading operations.

-Soil and rock from excavation work will be used as fill or stored in compacted mounds and seeded if necessary to prevent wind and rain erosion.

-Spoil material from excavation work will be wasted in preselected areas as fill, graded to conform to surrounding landscape, covered with topsoil, seeded, and mulched to avoid erosion.

-Impacts due to chemical discharges to the reservoir will be minimized by the use of holding ponds, neutralization, and other treatment which may be required to reduce concentrations substantially below harmful levels.

-Extended aeration treatment of sanitary wastes and chlorination of effluent will be provided during construction.

Operation of the Hartsville plant will result in small amounts of heat, chemical, sanitary, and radioactive liquid wastes being discharged into the Old Hickory Reservoir. Mitigation of possible related effects will be accomplished as follows:

-Closed-cycle natural draft cooling towers will minimize the quantity of waste heat discharged to the receiving waters.

-A diffuser will rapidly mix the heated cooling tower blowdown with unheated reservoir water.

-Secondary treatment of the sanitary wastes with provision for effluent chlorination will be provided for the permanent plant.

-Radioactive waste liquids will be treated by evaporation and the distillate will be recycled to the extent practicable.

As indicated, adequate treatment of liquid effluents is provided before being discharged to ensure that all applicable standards are met and that the quantities and concentrations released will be small enough to ensure that any adverse environmental effects are minimal. Water, aquatic life, and life systems will be carefully monitored to detect possible adverse environmental effects, although some adverse effects may be undetectable.

5.6.2 Air Pollution - The construction of this facility will result in a minimal short duration impact to the atmosphere from selected burning of cleared brush and trash.

There will be some radioactive gaseous wastes released to the atmosphere and some negligible additions of nonradioactive gaseous emissions to the atmosphere. Some local accumulation of dissolved solids may take place on surfaces exposed to the drift from the cooling towers. In addition, large quantities of waste heat and moisture from the cooling tower plumes may result in some alteration of the local atmospheric conditions. During adverse weather conditions,

this increased moisture content may cause local fogging and icing. However, such occurrences resulting from the operation of the cooling towers should be infrequent. To the extent that local fogging and icing occur, it represents an unavoidable adverse environmental effect.

Mitigation of the probably related effects from these discharges to the atmosphere is accomplished as follows:

-Brush and trash burning will be done in accordance with applicable state regulations and as atmospheric conditions permit.

-Radioactive gaseous waste will be treated as required to reduce radiological doses to levels as low as practicable.

-Natural draft hyperbolic cooling towers disperse heat and moisture to the atmosphere about 500 feet above the ground.

-Cooling tower design will keep water losses due to drift from the cooling towers to a minimum.

No significant adverse environmental effects should be caused by these releases to the atmosphere.

5.6.3 Impact on Land Use - The construction and operation of the Hartsville Nuclear Plant will result in a change in land use of approximately 1,940 acres from predominantly farming and pasture to industrial use. In addition, right of way easements will be obtained on approximately 5,400 acres of land. Approximately 40 percent of this acreage is forested and will be removed from this land use category. This accounts for about 0.12 percent of the forested land in the counties traversed by these corridors.

The land use adjustments are not judged to be significant adverse environmental impacts.

5.6.4 Damage to Life Systems - When the auxiliary cooling water and cooling tower makeup water pass through the traveling screens, some fish will be impinged and fish larvae and plankton will be drawn into the water intake. These will be killed in passing through the closed cooling system. Some of the plankton and larval fish drawn into the water intakes and killed still serve as a food source for other organisms, but destruction of the remainder is an adverse effect which cannot be avoided. However, the relatively small quantity of water required and the proposed design and location of the water intake facilities will minimize these effects.

5.6.5 Accidental Releases of Radioactive Materials - The facility is being designed and constructed and will be operated in accordance with all applicable regulations in order that the health and safety of the public will be safeguarded.

Significant accidental releases of radioactive products at the plant or during transportation of radioactive materials are very improbable. Should such a release occur, implementation of the radiological emergency plans would mitigate the potential risk to the public.

5.6.6 Socioeconomic Effects - The construction and operation of the plant will have an economic and social impact. Although the plant will provide an economic stimulus to the region, stress on present institutions, such as schools and housing facilities, will unavoidably result in placing a greater demand on both the public and private sectors to provide the necessary community services.

5.6.7 Other Effects - Construction of the plant will necessitate the disturbance of archaeological sites present on the plant site. These will, however, be investigated in order to record or preserve to the extent necessary the significant value of their contents to minimize the impact.

Construction of the plant will necessitate relocation of approximately 50 people. Assistance will be provided, as appropriate, to mitigate the effects associated with the relocation.

5.7 Resources Committed

The construction and operation of the Hartsville plant will entail the commitment, both reversible and irreversible, of certain resources. In addition, this section assesses the relationship between short-term use and the maintenance and enhancement of long-term productivity. In general, the short-term uses of land, water, and other resources will result in no significant effect on the long-term productivity of the region.

5.7.1 Fuel Resources - Operation of the reactor will require a commitment of approximately 304,000 pounds of uranium for each reactor core. The annual commitment of uranium will be about one-third of the above amount per unit. A small quantity of fuel oil will be required for the operation of auxiliary boilers and testing of diesel generators. To the extent that these fuels are consumed and not subject to recycle for other uses, this represents an irreversible and irretrievable commitment of resources. Fuel commitments for plant construction are discussed in Section 4.4.

5.7.2 Land and Water Resources

5.7.2.1 Fish and Wildlife - As discussed in Section 5.1, operation of the Hartsville plant will result in losses of aquatic biota due to entrainment and impingement. This represents an irretrievable commitment. However, it is not expected that these losses will be large enough to have any significant effect on the overall, long-term effect on the reservoir ecology.

A commitment of approximately 350 acres of terrestrial habitat will be made for the plant. A portion of this land may be irretrievably committed, depending on the method of decommissioning selected for the plant. As discussed in Section 2.7, the acreage in question has been extensively farmed with the majority of the land presently being in pasture. Because of this present land use and location of plant facilities, an insignificant amount of wildlife habitat will be committed.

Additionally, it is estimated that about 5,400 acres of land will be utilized for transmission line rights of way. There will be a commitment of approximately 2,311 acres of forest land. It is expected that this commitment would be mitigated since the altered habitat also has the potential for attracting new wildlife species and establishing a new ecological community.

5.7.2.2 Agricultural - The site's agricultural land use is discussed in Section 2.2.4. Table 5-15 presents the estimated annual average agricultural production at the Hartsville nuclear plant site during the last five years by type of crop, acreage, yield, and value of production. Prices used were the seasonal average prices for the 1972 crop year. These prices were used as being more representative of prices that have been or may be received by farmers than those that existed in 1973 and the first half of 1974. This is due to the extreme variability of farm product prices that occurred during 1973 and the first half of 1974.[a] Based on 1972 prices, the estimated annual value of agricultural production at the plant site during the past five years has been approximately $260,000.

Table 5-16 presents the estimated crop and pasture yields possible under two levels of management--A, medium or average, and B, good or that which exists on the best managed farms--for each land capability subclass. A crop production potential can be calculated for each of the crops listed in Table 5-16 for the two management levels. For example, if all suitable land were planted to corn, total production would amount to 58,002 bushels under level A management, or 86,249 bushels under level B management (Table 5-16). It is assumed that land not suited to cultivated crop production would be in pasture or trees. In practical terms, not all cultivable land would be planted to any single crop even though this is the assumption on which Table 5-16 is based. Hence, even though the plant site has a potential of producing 58,002 bushels of corn, or 1,753,702 pounds of tobacco, or 442 cow-calf units,[b] using good management practices, the data in Table 5-15 provides a more realistic measure of agricultural production that will be affected by the construction of the Hartsville Nuclear Plant.

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a. For example, between July 15, 1972, and July 15, 1973, prices received by U.S. farmers increased by about 100 percent for wheat, corn, and soybeans. However, the largest increases occurred after July 15, 1973, followed by decreases during the first four months of 1974.

b. Consists of one brood cow plus her calf.

The entire site area will be removed from agricultural production for the life of the plant. This represents an irretrievable commitment of the agricultural products which could have been produced during the period of plant construction and operation. The total area in agricultural production in Smith and Trousdale Counties is 109,129 acres. The Hartsville site has about 1,750 acres currently in agricultural production, which is only 1.6 percent of the total for the 2-county area.

Since the exact method of decommissioning has not been definitely determined, the land directly under the reactor systems buildings may be irretrievably committed. However, a majority of the land on the site could be made available for other uses, including agriculture, after plant decommissioning.

The erection and maintenance of electrical transmission facilities will preclude the production of certain products during the life of the transmission lines; however, the transmission lines will not preclude land use for standard agricultural purposes and agricultural production on the transmission rights of way may actually increase due to TVA reseeding practices discussed previously.

Approximately 15,000 cords of pulpwood and 4,850,000 bd.ft. of saw timber will be removed from the forested portions of the transmission corridors. Timber to be removed will be marketed where feasible. Productivity of the forested area traversed is estimated to be 45 cu.ft. per acre per year. This represents a commitment of 0.19 percent of the annual forest productivity of the twelve counties traversed by the corridors.

<u>5.7.2.3 Potential Recreation</u> - Plant construction and operation should have little or no adverse impact on existing or potential recreation. The low density recreation activities which occur in the immediate region should continue essentially unaffected. A length of shoreline will be removed from any potential for recreational use, however, this commitment is not irreversible since the shoreline could be made available for non-industrial uses following plant life. As discussed in Section 5.7.2.1, no significant adverse irreversible effects on the fish or wildlife populations of the area are expected. Therefore, no long-term adverse impact on recreational fishing or hunting is anticipated. Construction and operation of the plant will not significantly impact water available for recreation either by streamflow alteration, consumptive use, or contamination of water. TVA expects that future recreation in the immediate region will remain essentially unaffected by the plant.

<u>5.7.2.4 Potential Industry</u> - Existing industrial locations nearest the plant site are located in the city of Hartsville. The construction and operation of the plant will not adversely affect these industries.

The land to be utilized for the plant is not now used for industrial purposes. Projections do not call for any industrial growth

in the area which would conflict with plant construction and operation. It is not expected that the plant would adversely affect industrial growth in the area for any reason.

5.7.3 Other Resources - At present, no mineral resources are being worked in the area; however, several private companies have explored for zinc ore in areas slightly beyond the exclusion radius of the plant. In an effort to evaluate ore potential, which might be jeopardized by the plant, TVA combined with Cominco American, owner of mineral rights beneath the property, to drill two deep holes into the assumed ore bearing horizons. Neither hole indicated mineral concentrations which could be considered economically feasible, nor were other resources such as natural gas or oil encountered. It is therefore concluded that no mineral resources are being committed within the plant site.

5.7.4 Short-Term Uses Versus Long-Term Productivity - The construction and operation of the Hartsville plant will result in short-term uses of the environment for the production of electrical power. The adverse effects of these short-term uses will be minimal and are expected to have no long-term impacts on the environment and its productivity. The cumulative effect of the plant will be a localized shift of land usage to meet the demand for power.

Most of the short-term uses of the site itself will result in no significant adverse effect on the long-term productivity of the land directly affected or of the general area. As discussed in Section 4.1, construction will be carried out in such a manner as to minimize impacts on long-term productivity. In addition, the atmosphere, and, to a much lesser extent, the Cumberland River will be used for the dissipation of waste heat. Any thermal discharges to the river will be within applicable standards and should have no appreciable effect on either the short-term or the long-term productivity of the receiving waters. Radioactive discharges will be negligible. Neither radioactive nor chemical discharges will hamper other short-term uses or alter the long-term productivity of the environment.

Where transmission lines traverse forested areas, timber production is lost for the life of the line. However, the forest productivity lost is only .19 percent of the annual total for the 12 county area affected. Furthermore, there are offsetting benefits such as increased acreages of cleared land available for agricultural uses and other compatible uses of the corridors.

The environmental monitoring programs will provide data necessary for detecting and evaluating any specific environmental impacts which might lead to long-term effects, so that corrective action can be undertaken.

The construction and operation of the Hartsville Nuclear Plant will be carried out in such a manner as to minimize as much as practicable adverse environmental impacts in order to pass on to future generations an environment with its potential productivity essentially unimpaired.

5.8 Decommissioning and Dismantling

No specific plan for decommissioning the plant has been developed. The long-term commitment of land and environmental consequences of decommissioning cannot be adequately determined until a decommissioning plan has been selected. Near the end of the plant's useful life, TVA will prepare a proposed decommissioning plan for submittal to AEC for review. The plan will comply with regulations then in effect. Decommissioning will not commence until authorized by AEC. To date, experience with decommissioning of civilian nuclear power reactors is limited to six facilities which have been shut down or dismantled: Hallam Nuclear Power Facility, Carolina Virginia Tube Reactor (CVTR), Boiling Nuclear Superheater (BONUS) Power Station, Pathfinder Reactor, Piqua Reactor, and the Elk River Reactor.

There are several alternatives which can be and have been used in decommissioning of reactors: (1) Remove the fuel (possibly followed by decontamination procedures); seal and cap the pipes; and establish an exclusion area around the facility. The Piqua decommissioning operation was typical of this approach. (2) In addition to the steps outlined in (1), remove the superstructure and encase in concrete all radioactive portions which remain above ground. The Hallam decommissioning operation was of this type. (3) Remove the fuel, all superstructure, the reactor vessel and all contaminated equipment and facilities, and finally fill in cavities with clean rubble topped with earth to grade level. This last procedure is being applied in decommissioning the Elk River Reactor. Alternative decommissioning procedures (1) and (2) would require long-term surveillance of the reactor site. After a final check to assure that all reactor-produced radioactivity has been removed, alternative (3) would not require any subsequent surveillance. Possible effects of erosion or flooding will be included in these considerations.

The design of the plant will be such that none of the decommissioning alternatives are precluded, and the variety of choice will be maintained until the end of useful plant life.

The degree of dismantlement will be determined by an economic and environmental study which takes into account the value of the land and salvage values as well as other relevant factors. In any event, the decommissioning operation will be controlled by rules and regulations to protect the health and safety of the public that are in effect at the time.

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Table 5-1

AVERAGE RADIONUCLIDE CONCENTRATIONS IN LIQUIDS

Nuclide	Plant Effluent (μCi/g)	Cumberland River[a] (μCi/g)
H-3	2.0 (-6) *	2.6 (-8)
Na-24	8.0 (-13)	1.0 (-14)
P-32	8.0 (-15)	1.0 (-16)
Cr-51	2.0 (-13)	2.6 (-15)
Mn-54	1.6 (-14)	2.0 (-16)
Mn-56	2.0 (-11)	2.6 (-13)
Fe-59	3.2 (-14)	4.1 (-16)
Co-58	2.0 (-12)	2.6 (-14)
Co-60	2.0 (-13)	2.6 (-15)
Ni-65	1.2 (-13)	1.5 (-15)
Zn-65	8.0 (-16)	1.0 (-17)
Zn-69m	1.2 (-14)	1.5 (-16)
Br-83	5.2 (-12)	6.6 (-14)
Br-84	1.1 (-11)	1.4 (-13)
Br-85	7.2 (-12)	9.2 (-14)
Sr-89	9.3 (-13)	1.2 (-14)
Sr-90	6.8 (-14)	8.7 (-16)
Sr-91	2.2 (-11)	2.8 (-13)
Sr-92	4.0 (-11)	5.1 (-13)
Zr-95	1.2 (-14)	1.5 (-16)
Zr-97	1.0 (-14)	1.3 (-16)
Nb-95	1.2 (-14)	1.5 (-16)
Mo-99	6.8 (-12)	8.7 (-14)
Tc-99m	2.8 (-11)	3.6 (-13)
Tc-101	5.6 (-11)	7.2 (-13)
Ru-103	6.0 (-15)	7.7 (-17)
Ru-106	7.6 (-16)	9.7 (-18)
Ag-110m	2.4 (-14)	3.1 (-16)
Te-129m	1.0 (-13)	1.3 (-15)
Te-132	4.4 (-12)	5.6 (-14)
I-131	4.4 (-12)	5.6 (-14)
I-132	4.4 (-11)	5.6 (-13)
I-133	3.0 (-11)	3.8 (-13)
I-134	9.3 (-11)	1.2 (-12)
I-135	4.4 (-11)	5.6 (-13)
Cs-134	4.8 (-14)	6.1 (-16)
Cs-136	3.2 (-14)	4.1 (-16)
Cs-137	7.2 (-14)	9.2 (-16)
Cs-138	7.6 (-11)	9.7 (-13)
Ba-139	6.0 (-11)	7.7 (-13)
Ba-140	2.7 (-12)	3.5 (-14)
Ce-141	1.2 (-14)	1.5 (-16)
Ce-143	1.1 (-14)	1.4 (-16)
Ce-144	1.0 (-14)	1.3 (-16)
Pr-143	1.2 (-14)	1.5 (-16)
Nd-147	4.4 (-14)	5.6 (-16)
W-187	1.2 (-12)	1.5 (-14)
Np-239	7.6 (-11)	9.7 (-13)

a. Dilution is calculated assuming an average flow of 17,600 ft^3/s and mixing with one-half of the river flow.

* 2.0(-6) = 2.0 X 10^{-6}

Table 5-2

CONCENTRATION FACTORS FOR AQUATIC ORGANISMS

Nuclide	Half-life (days)	Radionuclide Concentration Factors[a, b, c] Fish	Invertebrates	Plants
H-3	4.5 (+3)*	1.0	1.0	1.0
Na-24	6.3 (-1)	1.0 (+2)	2.0 (+2)	5.0 (+2)
P-32	1.4 (+1)	1.0 (+5)	2.0 (+4)	5.0 (+5)
Cr-51	2.8 (+1)	2.0 (+2)	2.0 (+3)	4.0 (+3)
Mn-54	3.0 (+2)	4.0 (+2)	1.4 (+5)	3.5 (+4)
Mn-56	1.1 (-1)	4.0 (+2)	1.4 (+5)	3.5 (+4)
Fe-59	4.6 (+1)	1.0 (+2)	3.2 (+3)	1.0 (+3)
Co-58	7.1 (+1)	2.1 (+1)	1.8 (+2)	6.2 (+3)
Co-60	1.9 (+3)	4.8 (+1)	2.0 (+2)	6.2 (+3)
Ni-65	1.1 (-1)	1.0 (+2)	1.0 (+2)	5.0 (+1)
Zn-65	2.5 (+2)	1.4 (+3)	9.6 (+3)	2.0 (+4)
Zn-69m	5.8 (-1)	1.1 (+1)	5.4 (+2)	2.0 (+4)
Zn-69	4.0 (-2)	0.8	3.9 (+1)	2.0 (+4)
Br-83	1.0 (-1)	4.2 (+2)	3.3 (+2)	5.0 (+1)
Br-84	2.2 (-2)	4.2 (+2)	3.3 (+2)	5.0 (+1)
Br-85	2.1 (-3)	4.2 (+2)	3.3 (+2)	5.0 (+1)
Kr-83m	7.8 (-2)	1.0	1.0	1.0
Kr-85m	1.8 (-1)	1.0	1.0	1.0
Kr-85	3.9 (+3)	1.0	1.0	1.0
Sr-89	5.3 (+1)	1.0 (+1)	4.0 (+3)	3.0 (+3)
Sr-90	1.0 (+4)	3.0 (+1)	4.0 (+3)	3.0 (+3)
Sr-91	4.0 (-1)	1.2 (-1)	3.2 (+3)	3.0 (+3)
Sr-92	1.1 (-1)	3.4 (-2)	2.1 (+3)	3.0 (+3)
Y-90	2.7	2.5 (+1)	1.0 (+3)	5.0 (+3)
Y-91m	3.5 (-2)	2.5 (+1)	1.0 (+3)	5.0 (+3)
Y-91	5.9 (+1)	2.5 (+1)	1.0 (+3)	5.0 (+3)
Y-92	1.5 (-1)	2.5 (+1)	1.0 (+3)	5.0 (+3)
Zr-95	6.6 (+1)	3.3	6.7	1.0 (+3)
Zr-97	7.1 (-1)	3.3	6.7	1.0 (+3)
Nb-95m	3.8	3.0 (+4)	1.0 (+2)	8.0 (+2)
Nb-95	3.5 (+1)	3.0 (+4)	1.0 (+2)	8.0 (+2)
Nb-97	5.0 (-2)	3.0 (+4)	1.0 (+2)	8.0 (+2)
Mo-99	2.8	1.0 (+1)	1.0 (+1)	1.0 (+3)
Tc-99m	2.5 (-1)	1.5 (+1)	5.0	4.0 (+1)
Tc-101	9.9 (-3)	1.5 (+1)	5.0	4.0 (+1)
Ru-103	4.0 (+1)	1.0 (+1)	3.0 (+2)	2.0 (+3)
Ru-106	3.7 (+2)	1.0 (+1)	3.0 (+2)	2.0 (+3)
Rh-103m	4.0 (-2)	1.0 (+1)	3.0 (+2)	2.0 (+2)
Ag-110m	2.5 (-2)	2.0	7.7 (+2)	2.0 (+2)
Te-129m	3.4 (+1)	4.0 (+2)	1.0 (+3)	1.0 (+3)
Te-129	4.8 (-2)	4.0 (+2)	1.0 (+3)	1.0 (+3)
Te-132	3.2 (-1)	4.0 (+2)	1.0 (+3)	1.0 (+3)
I-129	6.2 (+9)	5.0 (+1)	1.0 (+3)	2.0 (+2)
I-131	8.1	4.5 (+1)	1.0 (+3)	2.0 (+2)
I-132	9.4 (-2)	4.3	1.0 (+3)	2.0 (+2)

Table 5-2
(continued)

CONCENTRATION FACTORS FOR AQUATIC ORGANISMS

Nuclide	Half-life (days)	Radionuclide Concentration Factors[a, b, c] Fish	Invertebrates	Plants
I-133	8.5 (-1)	2.3 (+1)	1.0 (+3)	2.0 (+2)
I-134	3.6 (-2)	1.7	1.0 (+3)	2.0 (+2)
I-135	2.8 (-1)	1.1 (+1)	1.0 (+3)	2.0 (+2)
Xe-133m	2.3	1.0	1.0	1.0
Xe-133	5.3	1.0	1.0	1.0
Xe-135m	1.1 (-2)	1.0	1.0	1.0
Xe-135	3.8 (-1)	1.0	1.0	1.0
Cs-134	7.5 (+2)	2.0 (+3)	9.9 (+3)	2.5 (+4)
Cs-136	1.4 (+1)	1.9 (+3)	5.8 (+3)	2.5 (+4)
Cs-137	1.1 (+4)	2.0 (+3)	1.0 (+4)	2.5 (+4)
Cs-138	2.2 (-2)	4.4 (+1)	2.2 (+1)	2.5 (+4)
Ba-139	5.8 (-2)	4.0	2.0 (+2)	5.0 (+2)
Ba-140	1.3 (+1)	4.0	2.0 (+2)	5.0 (+2)
La-140	1.7	2.5 (+1)	1.0 (+3)	5.0 (+3)
Ce-141	3.3 (+1)	2.5 (+1)	1.0 (+3)	4.0 (+3)
Ce-143	1.4	2.5 (+1)	1.0 (+3)	4.0 (+3)
Ce-144	2.8 (+2)	2.5 (+1)	1.0 (+3)	4.0 (+3)
Pr-143	1.4 (+1)	2.5 (+1)	1.0 (+3)	5.0 (+3)
Pr-144	1.2 (-2)	2.5 (+1)	1.0 (+3)	5.0 (+3)
Nd-147	1.1 (+1)	2.5 (+1)	1.0 (+3)	5.0 (+3)
Pm-147	9.6 (+2)	2.5 (+1)	1.0 (+3)	5.0 (+3)
W-187	1.0	1.2 (+3)	1.0 (+1)	1.2 (+3)
Np-239	2.4	1.0 (+1)	4.0 (+2)	3.0 (+2)

$*4.5(+3) = 4.5 \times 10^3$

a. S. E. Thompson, et al, "Concentration Factors of Chemical Elements in Edible Aquatic Organisms," UCRL-50564, Rev. 1, 1972.
b. D. E. Reichle, et al, "Turnover and Concentration of Radionuclides in Food Chains," Nuclear Safety 11, No. 1 (1970).
c. Personal Communication, S. V. Kaye, Oak Ridge National Laboratory, 1972.

Table 5-3

MAXIMUM GASEOUS RADIONUCLIDE CONCENTRATIONS AT THE SITE BOUNDARY (WSW SECTOR)

Nuclide	Air Concentration ($\mu Ci/cm^3$)	Ground Concentration ($\mu Ci/m^2$)
Tritium	5.8 (-11)*	2.8 (+1)
Kr-85m	1.9 (-11)	4.2 (-9)
Kr-85	5.8 (-10)	2.5 (-3)
Kr-87	2.0 (-11)	1.3 (-9)
Kr-88	4.9 (-11)	7.1 (-9)
Rb-88	3.3 (-11)	5.0 (-5)
I-131	1.5 (-14)	8.9 (-5)
I-131[a]	1.6 (-14)	9.6 (-7)
I-132	1.6 (-13)	1.9 (-5)
I-133	1.2 (-13)	1.3 (-4)
I-134	1.7 (-13)	7.5 (-6)
I-135	1.6 (-13)	5.3 (-5)
Xe-131m	3.7 (-19)	5.4 (-7)
Xe-133m	3.2 (-17)	3.0 (-6)
Xe-133	2.9 (-9)	1.5 (-4)
Xe-135m	6.5 (-11)	1.4 (-5)
Xe-135	5.7 (-10)	5.4 (-5)
Xe-138	8.6 (-11)	1.3 (-9)
Cs-135	1.2 (-20)	1.3 (-8)
Cs-138	5.6 (-11)	1.6 (-4)

*5.8(-11) = 5.8×10^{-11}

a. Nonelemental forms.

Table 5-4

ANNUAL DOSES TO AQUATIC ORGANISMS LIVING IN THE CUMBERLAND RIVER NEAR THE HARTSVILLE NUCLEAR PLANT

	Dose Estimates		
	Internal (mrad/y)		
Organism	Effective Radius 3-cm	Effective Radius 30-cm	External (mrad/y)
Plants	4.4 (-1)*	1.5	4.9 (-4)
Invertebrates	7.4 (-1)	1.4	4.9 (-4) suspended
			1.2 (-1) benthic
Fish	8.4 (-3)	1.4 (-2)	4.9 (-4)

$*4.4(-1) = 4.4 \times 10^{-1}$

Table 5-5

ANNUAL DOSES TO TERRESTRIAL ORGANISMS LIVING NEAR THE HARTSVILLE NUCLEAR PLANT

Organism	Dose Estimates Internal (mrad/y)	External (mrad/y)	Total (mrad/y)
Cattle (thyroid)	6.6 (+2)*	5.4	6.7 (+2)
Ducks and muskrats	1.1 (-1)	5.4	5.5
Plants		11	11

*6.6(+2) = 6.6 X 10^2

Table 5-6

CUMBERLAND RIVER DRINKING WATER SUPPLY INTAKES DOWNSTREAM
FROM THE HARTSVILLE NUCLEAR PLANT

System	County	Location (CRM)	Distance (miles)	Population Served 2020
Hartsville	Trousdale, Tn.	278.6	6.4	4,500
Lebanon	Wilson, Tn.	262.9	22.1	61,400
Gallatin St. Pl.	Sumner, Tn.	243.6	41.4	800
Gallatin	Sumner, Tn.	239.2	45.8	50,400
Camp Boxwell	Sumner, Tn.	236.0	49.0	2,100
ESC Children's Camp	Sumner, Tn.	236.0	49.0	1,600
Old Hickory Ut. Dist.	Davidson, Tn.	219.0	66.0	26,100
Whitehouse Ut. Dist.	Davidson, Tn.	216.5	68.5	25,600
Old Hickory Dam Rec. Area	Davidson, Tn.	216.2	68.8	12,500
Cumberland Water Co.	Davidson, Tn.	207.7	77.3	20,900
Madison Sub. Ut. Dist.	Davidson, Tn.	200.2	84.8	70,400
Nashville	Davidson, Tn.	193.8	91.2	934,700
Harpeth Valley Ut. Dist.	Davidson, Tn.	172.5	112.5	39,400
River Road Ut. Dist.	Cheatham, Tn.	159.9	125.1	1,400
Cheatham Dam Rec. Area	Cheatham, Tn.	148.7	136.3	7,100
Clarksville	Montgomery, Tn.	126.5	158.5	121,000
Dover	Stewart, Tn.	89.5	195.5	2,000
Kentucky State Penit.	Lyon, Ky.	43.7	241.3	2,100
Barkley Dam Rec. Area	Lyon, Ky.	30.6	254.4	3,300

Table 5-7

SUMMARY OF ANNUAL DOSES TO INDIVIDUALS FROM LIQUID EFFLUENTS[a]

Location/Pathway	Dose Estimates (mrem/y)				
	Total Body	Skin	G.I. Tract	Bone	Thyroid
Hartsville					
Water ingestion	1.5 (-3)*	1.5 (-3)	1.5 (-3)	1.5 (-3)	1.7 (-3)
Effluent Discharge Region					
Shoreline (500 h/y)	3.5 (-6)	4.1 (-6)	3.5 (-6)	3.5 (-6)	3.5 (-6)
Swimming (900 h/y)	5.7 (-4)	5.9 (-4)	5.7 (-4)	5.7 (-4)	5.7 (-4)
Fishing, boating (1,800 h/y)	1.4 (-5)	2.5 (-5)	1.4 (-5)	1.4 (-5)	1.4 (-5)
Fish ingestion (20 kg/y)	2.8 (-5)	2.8 (-5)	5.0 (-5)	4.7 (-5)	8.3 (-5)
Duck ingestion (470 g)[b]	1.2 (-3)	1.2 (-3)	1.7 (-4)	7.9 (-3)	1.3 (-3)

a Reference Appendix I1 of the Hartsville Nuclear Plant Environmental Report for details.

b Maximum doses per duck ingested.

*1.5 (-3) = 1.5×10^{-3}

Table 5-8

SUMMARY OF ANNUAL DOSES TO INDIVIDUALS FROM GASEOUS EFFLUENTS[a]

Loaction/Pathway (WSW Sector)	X/Q (s/m^3)	Dose Estimates (mrem/y) Total Body	Skin	Thyroid
Site Boundary	9.1 (-6)*			
Submersion		4.8	10	4.8
Ground concentration		4.6 (-2)	5.3 (-2)	4.6 (-2)
Tritium transpiration		4.1 (-2)	4.1 (-2)	4.1 (-2)
Inhalation		7.7 (-2)	7.7 (-2)	9.7 (-1)
Nearest Residence	5.5 (-6)			
Submersion		2.6	5.9	2.6
Ground concentration		2.8 (-2)	3.2 (-2)	2.8 (-2)
Tritium transpiration		2.5 (-2)	2.5 (-2)	2.5 (-2)
Inhalation		4.7 (-2)	4.7 (-2)	5.6 (-1)
Ingestion (leafy veg.)		3.2 (-3)	3.2 (-3)	1.8
Nearest Grazable Land	9.1 (-6)			
Ingestion (milk)		4.9 (-3)	4.9 (-3)	2.8

a Reference Appendix I1 of the Hartsville Nuclear Plant Environmental Report for details.

* 9.1 (-6) = 9.1×10^{-6}

Table 5-9

SUMMARY OF ANNUAL DOSES TO INDIVIDUALS FROM DIRECT RADIATION

	Maximum Dose Estimate (mrem/y)			
	Site Boundary		Residence	
Direction	Condensate Storage Tank	N-16 Air Scatter	Condensate Storage Tank	N-16 Air Scatter
ESE	6 (-5)*			
SSE		2.2		
W			9 (-6)	
N				1.5

* 6 (-5) = 6 X 10^{-5}

Table 5-10

ANNUAL QUANTITIES AND ACTIVITIES
OF RADWASTE MATERIALS EXPECTED
FROM 4-UNIT OPERATION*

Type of Waste	Annual Weight (lbs.)	Annual Volume (ft^3)	Expected[a] Activity (Ci/ft^3)	Raw Form
Spent powdered resin	137,100	2,200	0.48	Solid
Spent bead resin	757,700	12,800	0.07	Solid
Miscellaneous dry solids	240,000	6,000	<0.01	Solid
Air filters	1,560	96	<0.01	Solid
Waste sludge	74,500	1,200	0.06	Liquid
Waste evaporator bottoms	3,026,400	48,800	0.05	Liquid

* Based on 80-percent capacity factor.

a Activities shown are specific activities for the particular waste and do not reflect mixing with cement.

Table 5-11

Annual Shipments, Package Weights, and Activities from 4-Unit Operation (80% Capacity Factor)

Type Waste	Number of Shipments per Year	Estimated Package Weight (lbs)	Expected Activity per Package
Reactor Water Cleanup Spent Powdered Resin Spent Bead Type Resin	125*	45,000	66 Ci
Waste Sludge Waste Evaporator Bottoms	417*	45,000	13 Ci
Misc. Dry Solids	16**	300	.075 Ci
Air Filters	1**	250	.05 Ci

* Based on 120 ft^3 radwaste volume per 170 ft^3 container.

** More than one package per shipment.

Table 5-12

ANNUAL DOSES TO THE POPULATION IN THE VICINITY OF THE HARTSVILLE NUCLEAR PLANT

	Dose Estimates (man-rem/y)				
	Bone	Lung	G. I. Tract	Thyroid	Total Body
Ingestion (water)	9.5 (-1)*	9.5 (-1)	9.6 (-1)	9.8 (-1)	9.5 (-1)
Ingestion (fish)	2.6 (-3)	1.7 (-3)	2.5 (-3)	3.5 (-3)	1.7 (-3)
Ingestion (milk and leafy veg.)[a]	2.3 (-2)	1.8 (-2)	1.7 (-2)	10	1.8 (-2)
Inhalation	3.3 (-1)	8.7 (-1)	3.9 (-1)	3.0	3.9 (-1)

	Skin	Total Body
In-water sports	1.1 (-1)	1.1 (-1)
Above-water sports	2.8 (-5)	1.7 (-5)
Shoreline activities	1.3 (-5)	1.1 (-5)
Submersion in air	2.8 (+1)	8.6
Ground concentration	3.4 (-2)	2.9 (-2)
Direct radiation from facility		6.7 (-2)
Transportation of radioactive matter		7.0 (-2)

a Radioiodine only.

* $9.5\ (-1) = 9.5 \times 10^{-1}$

Table 5-13

EXPECTED CONCENTRATIONS OF EFFLUENTS FROM CCW COOLING TOWER BLOWDOWN

				Natural Draft Cooling Towers CF=6.6[4,5]		
Parameter	Cumberland River Water Quality[1]	Effluent Guideline[2]	Maximum Stream Limit[3]	Effluent Concentration	Concentration in River After Mixing	Dilution Water Required
	mg/l	mg/l	mg/l	mg/l	mg/l	gal.
Dissolved Solids	80	--	500	536	126	0
Suspended Solids	32	40	--	211	50	0
Ammonia	0.002	5.0	(0.5)	0.013	0.003	0
Fluoride	0.06	20.0	(1.0)	0.40	0.09	0
Chloride	3	--	(250)	20	4.7	0
Sulfate	25	1,400	(250)	170	42	0
Total Phosphate[6]	0.08	1.0	(0.08)	0.53	--	--
Silica	4.7	--	50[7]	31.0	7.3	0
Total Iron[6]	1.0	10.0	(0.3)	6.6	--	0
Manganese	0.12	10.0	(0.05)	0.79	--	--
Copper	*	1.0	(0.02)	--	--	--
Zinc	0.02	2.0	(0.1)	0.13	0.03	0
Chromium	*	3.0	(0.05)	--	--	--
Aluminum[6]	1.6	250	(1.0)	10.6	--	--
Nickel	*	3.0	(0.1)	--	--	--
Silver	*	0.05	(0.005)	--	--	--
Sodium	3.4	--	(100)	24.5	5.9	0
Potassium[6]	1.9	6.0	(1.9)	12.5	--	--
Lead	*	0.1	(0.05)	--	--	--
Mercury	0.0006	0.005	(0.005)	0.004	0.0009	0
Barium	*	5.0	(1.0)	--	--	--
Arsenic	*	1.0	(0.01)	--	--	--
Cadmium	*	0.01	(0.01)	--	--	--
Selenium	*	0.01	(0.01)	--	--	--
Boron	*	500	(1.0)	--	--	--

1. Maximum concentrations of parameters in grab sample taken from Cordell Hull Dam tailrace (CRM 313.5) in May, July, and September 1973.
2. Established by Tennessee Water Quality Control Board, January 1973.
3. Sources of maximum stream limits are Tennessee water quality standards and (guidelines) and Water Quality Criteria.
4. CF (concentration factor): factor by which concentrations of parameters in raw river water are multiplied in heat dissipation system during 30-hour holdup of blowdown.
5. Maximum concentration factor expected during operation of plant.
6. Concentrations of these parameters in raw river water equal or exceed maximum stream limit.
7. Maximum stream limit was attained from Water Quality Criteria.

* Below detectable limits.

Table 5-14

Spent Regenerant Discharges from Makeup Demineralizers

	Maximum Daily Pounds (Per 2-Unit Plant)	Average Annual Pounds (Per 2-Unit Plant)	Reservoir Conc. ppm	Maximum Daily Average Conc. in Cooling Water Blowdown ppm	Maximum Daily Average Δ Conc. in Reservoir ppm
1. Chemicals Added					
SO_4^{--}	1,410	123,600	25.0	4.80	0.480
Na^+	650	59,300	3.4	2.10	0.210
2. Minerals Removed from Treated Water					
Sodium Na^+	24	2,047	3.4	0.08	0.008
Sulfate SO_4^{--}	64	5,750	25.0	0.20	0.020
Chloride Cl^-	68	5,074	3.0	0.20	0.020
Total Dissolved Solids	351	32,000	80.0	1.20	0.120
3. Total Dissolved Solids	2,411	214,900	80.0	8.0	0.800

Table 5-15

Typical Annual Agricultural Production
Hartsville Nuclear Plant Site

Crop[b]	Acres[b]	Yield[b]	Unit	Price[c]	Value of Crop
Corn	200	100	Bushels	$1.50	$ 30,000
Tobacco	60	2,500	Pounds	.79	118,500
Fescue Seed	100[d]	200	Pounds	.10	2,000
Wheat	200[d]	40	Bushels	.90	7,200
Hay and Pasture	1,180	200[e]	Pounds	.42	99,120
Woods	200	-	-	-	-
Total	1,940				$256,820

Notes:

a. Estimated average production during the last five years for farms on the site.

b. Crops, acreage, and yields are Smith and Trousdale county agents' estimates as of July 1974.

c. Prices are season average prices, 1972 crop year, Tennessee Agricultural Statistics.

d. In the past five years fescue and wheat have sometime been produced on the plant site.

e. Hay and pasture yields have been converted to pounds of beef per acre assuming 500-pound marketing weight, 80 percent calf crop, and two acres per cow-calf unit. This converts to 200 pounds of beef per acre or approximately 600 cow-calf units.

Table 5-16

ESTIMATED CROP PRODUCTION POTENTIAL IF ALL ACRES OF LAND SUITABLE FOR CROP PRODUCTION SHOWN IN TABLE 5-15 WERE USED TO PRODUCE EACH GIVEN CROP BY CAPACITY SUBCLASS UNDER MEDIUM (A) AND GOOD (B) MANAGEMENT

Land Capability Subclass	Corn, Bushels		Tobacco, Pounds		Wheat, Bushels		Pasture Cow-Acre-Days	
	A	B	A	B	A	B	A	B
I	18,025	26,879	325,707	640,346	5,060	6,957	35,417	52,809
IIe	20,882	29,961	669,591	809,411	8,625	12,711	46,758	63,554
IIIe	9,166	14,143	336,018	401,493	4,714	6,548	25,666	35,357
IIIw	815	1,494	-	-	-	-	2,444	3,694
IVe	4,423	6,819	179,692	222,634	2,212	3,317	16,587	19,904
VIe	854	1,280	34,144	41,954	469	683	2,433	3,585
VIs	3,837	5,673	208,550	233,576	1,835	2,836	12,513	18,352
VIIs	-	-	-	-	-	-	19,400	27,645
Total	58,002	86,249	1,753,702	2,349,418	22,915	33,052	161,217	224,900
							(442)[a]	(616)[a]

a. Cow-calf units

Source: Computed from data in tables 5-15 and 5-17

Table 5-17

ESTIMATED AVERAGE ACRE YIELDS FOR PRINCIPAL CROPS
BY CAPABILITY SUBCLASS UNDER MEDIUM (A) AND GOOD (B) MANAGEMENT

Land Capability Subclass	Corn, Bushels		Tobacco, Pounds		Wheat, Bushels		Pasture, Cow-Acre-Days	
	A	B	A	B	A	B	A	B
I	57	85	1,030	2,025	16	22	112	167
IIe	46	66	1,475	1,783	19	28	103	140
IIIe	35	54	1,283	1,533	18	25	98	135
IIIw	30	55	-	-	-	-	90	135
IVs	24	37	975	1,208	12	18	90	108
VIe	20	30	800	983	11	16	57	84
VIs	23	34	1,250	1,400	11	17	75	110
VIIs	-	-	-	-	-	-	40	57

Source: Unpublished data, Soil Conservation Service, USDA.

*Example: In 1 percent of the total cases plumes extend 9 miles or more in the 22-1/2° sector ENE of the site.

Percent of total cases

Based on early morning record
February 1973 — January 1974

Figure 5-1 EXPECTED PLUME LENGTH AND FREQUENCY OF OCCURRENCE FOR 16 COMPASS POINT SECTORS NATURAL DRAFT (WET) COOLING TOWERS (ALL TEMPERATURES) HARTSVILLE NUCLEAR PLANTS

*Example: In 0.3 percent of the total cases plumes extend 7.7 miles or more in the 22-1/2° sector NE of the site.

Percent of total cases

Based on early morning record
February 1973 — January 1974

Figure 5-2 EXPECTED PLUME LENGTH AND FREQUENCY OF OCCURRENCE FOR 16 COMPASS POINT SECTORS
NATURAL DRAFT (WET) COOLING TOWERS
(TEMPERATURES ≤ 32°F)
HARTSVILLE NUCLEAR PLANTS

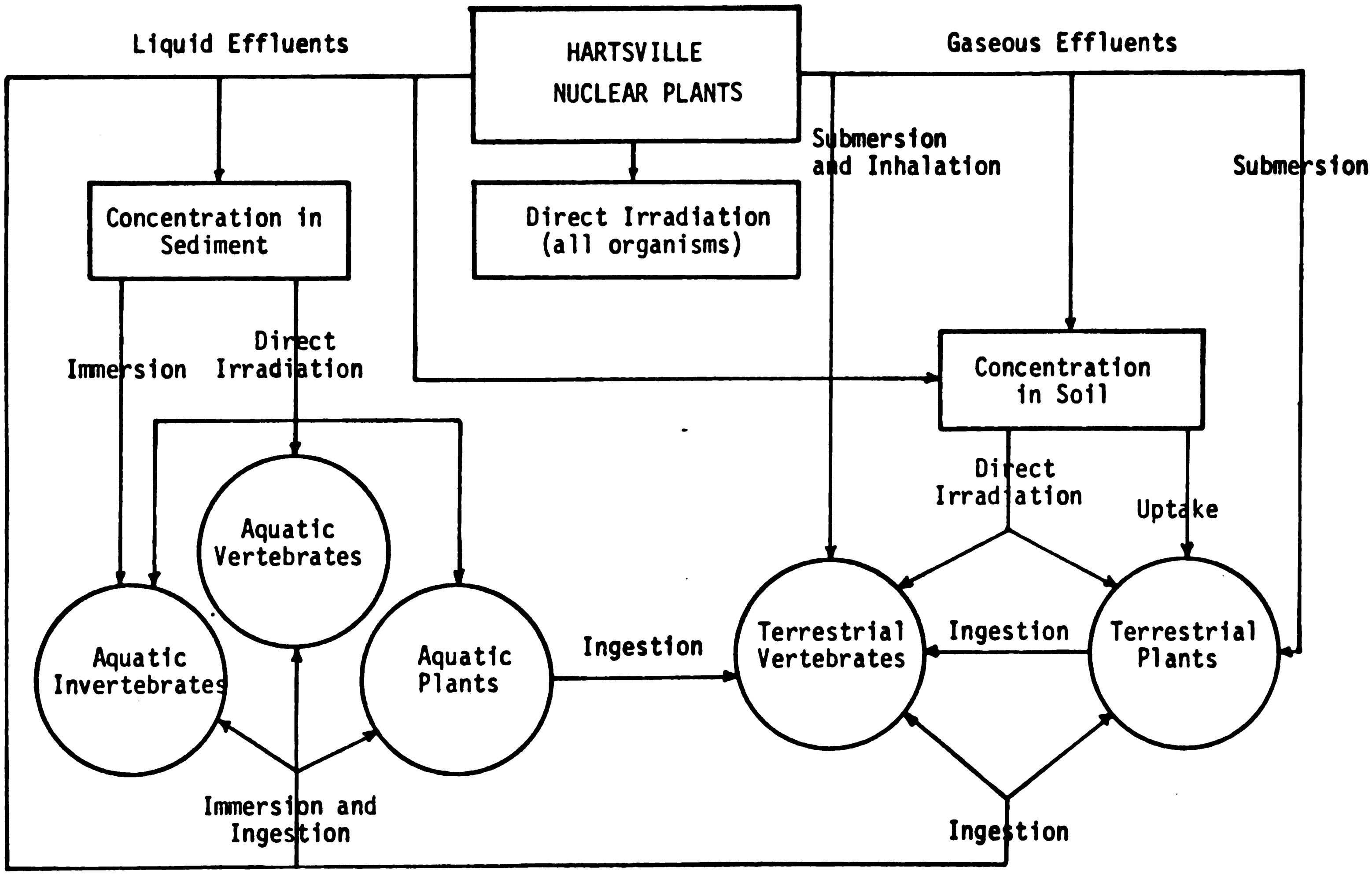

Figure 5-3

EXPOSURE PATHWAYS TO ORGANISMS
OTHER THAN MAN

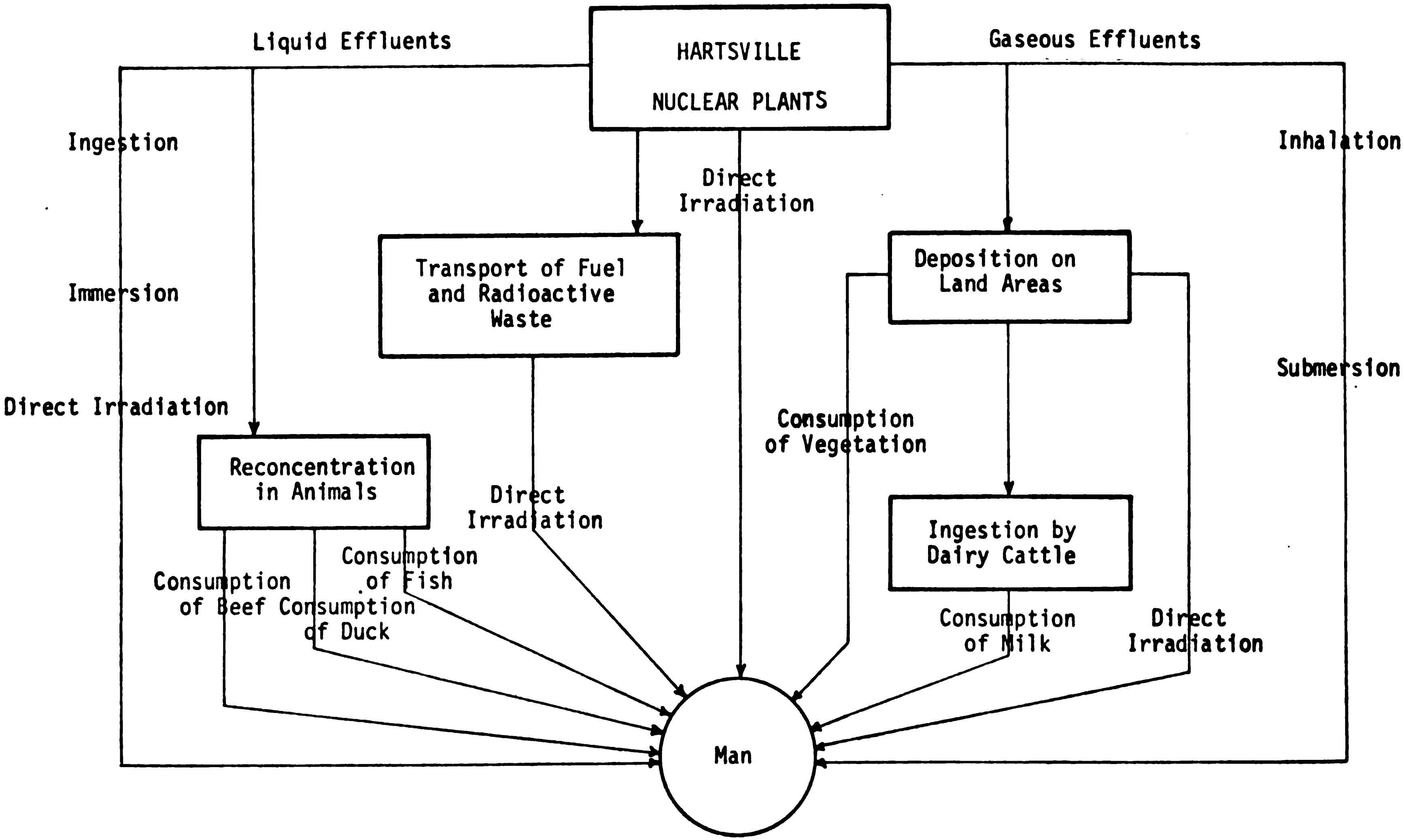

Figure 5-4

EXPOSURE PATHWAYS TO MAN

6.0 Effluent and Environmental Measures And Monitoring Programs

This chapter describes procedures and programs that will assess environmental impacts due to construction and operation of the Hartsville Nuclear Plant. Detailed information may be found in Chapter 6 of the environmental report.

The material is divided into preoperational and operational monitoring programs. Data obtained for impact assessment will be divided into three categories:

Baseline (preconstruction)—Data collected will describe the nonradiological terrestrial and aquatic conditions that exist at the plant site and its surroundings prior to the commencement of construction activities and/or operation of the Hartsville plant. Radiological assessments will be limited to monitoring only those vectors that may be affected by construction at the facility. These data serve as the base for subsequent evaluation of impacts due to construction, as well as compliance with applicable regulations on plant discharges during plant operation.

Construction— Monitoring programs will focus on those activities concerned with site preparation and plant construction. Emphasis will be placed on, but not limited to, detection of nonradiological changes in terrestrial environs, surface water, and limnological characteristics at the site.

Operation—Monitoring programs will be designed to ensure that operation of the plant will meet applicable regulations and radiological and nonradiological technical specifications and to assess effects of plant operation.

The monitoring program will be periodically reviewed and various elements may then be added to the program or deleted as appropriate.

6.1 Preoperational Environmental Programs

6.1.1 Surface Waters - Old Hickory Reservoir, Dixon Creek, Corley Branch and the unnamed creek to the east of Corley Branch, along with several small intermittent streams and small farm ponds, will be affected by construction and subsequent operation of the Hartsville Nuclear Plant. Consequently, a broad spectrum of parameters are being examined to obtain baseline data on the site and the surrounding surface waters.

6.1.1.1 Physical and Chemical Parameters

6.1.1.1.1 Baseline Monitoring - Water quality surveys are to include, but not be limited to, the following parameters according to TVA procedures[1,2] and the Environmental Protection Agency publication[3] on biological surveys at heated discharge locations: temperature, pH, conductivity, alkalinity, solids (total, dissolved, and suspended),

dissolved oxygen, five-day 20° C. BOD, COD, nitrogen series (nitrate, nitrite, organic, and ammonia), phosphorus (soluble and total), copper, nickel, zinc, chromium, coliforms (total and fecal), and acrolein and chlorine demand (one year only on quarterly basis). Additional parameters (for example: B, Na, SO_4, Mn, Cd, and Pb) will be monitored if necessary.

<u>6.1.1.1.2 Construction Monitoring</u> - Water quality surveys for construction monitoring will include the following: pH, temperature, dissolved oxygen, conductivity, coliforms, solids, turbidity, nutrients (nitrogen and phosphorus), and BOD. These parameters should reflect changes due to construction.

<u>6.1.1.2 Ecological Parameters</u>

<u>6.1.1.2.1 Fish Programs</u> - As part of the baseline monitoring program, fish will be sampled using various methods as appropriate such as gill nets, hoop nets, seines, electroshockers, and chemicals. The sampling will take place both above and below the plant and in Dixon Creek and will include both adult and larval fishes. In addition creel censuses will be made in the area. These measurements of fish species composition, abundance, and distribution will permit quantification and evaluation of aquatic losses due to construction of intake and discharge facilities, barge-docking facility, and earthfills.

<u>6.1.1.2.2 Limnological (Non-Fish) Program</u>

<u>Baseline Monitoring</u> - The primary effect of plant construction effluents, if any, will be on the aquatic community downstream from each point of discharge. Therefore, primary emphasis on biological changes will be placed on the benthic forms that spend most of their life cycle in one location on the river bottom. Principal macroinvertebrate populations in the area are being determined and enumerated. In addition, an artificial substrate sampling device is being utilized to more completely assess the potential biological impact.

<u>Construction Monitoring</u> - The purpose of construction monitoring is to ensure that adequate control measures are taken during construction to minimize any adverse effects in the aquatic environment. The most probable impact of construction will be caused by siltation, spillage, and sewage effluents.

Data analysis shall include, but not be limited to, a comparison between upstream and downstream stations and before and after construction data to demonstrate effects of construction.

<u>6.1.2 Ground Water</u> - Ground water samples will be analyzed for the following parameters: temperature, pH, conductivity, alkalinity, solids (total, dissolved, and suspended), chemical oxygen demand, nitrogen series (nitrate plus nitrite, organic and ammonia), Phosphorus (soluble and total), coliform (total and fecal), copper, nickel, zinc, chromium, boron, sodium, sulfate, manganese, cadmium, and lead.

6.1.3 Air - The principal objective of the environmental meteorological monitoring program during the preconstruction and construction phase is to establish an adequate data base from which preliminary assessments can be made of the low-level dispersion conditions in the site area and the air quality impacts on the local environment from plant operations.

Data are being collected on site by TVA and offsite at Nashville by the National Weather Service. Data being collected include wind direction and velocity, temperature, dew point, and stability.

6.1.4 Geology and Soils - Core drilling, percussion drills, caliper and sonic testing, and resistivity testing are being used to assess the geology of the site.

6.1.4.1 Land Use and Demographic Surveys - Land use information is obtained primarily through aerial photography supplemented by the Recreation Map for Old Hickory Reservoir, the General Plan, Hartsville, Tennessee, and the General Plan, Smith County, Tennessee. In addition, field trips to the site and vicinity provide additional insight.

Demographic Surveys - Present population data is based on the 1970 Census of Population. Future population is based on projections prepared for counties by the Social Science Advisory Committees for Tennessee and Kentucky and published by the Environmental Protection Agency[4] in July 1972.

6.1.4.1.1 Terrestrial Flora and Fauna - The preoperational terrestrial flora and fauna programs are designed to: (1) provide baseline ecological information of the project area; (2) provide information regarding site environs for project planning; (3) provide the basis for assessing effects of construction activities; and (4) establish a reference framework for assessing effects of plant operation.

Baseline or preconstruction investigations include a vegetation analysis, floristic inventory, and mammal, bird, reptile, and amphibian studies. Construction effects will be assessed by collecting and analyzing data from permanent plots on the project site. Offsite effects will be assessed by aerial photography and ground reconnaissance.

6.1.4.1.2 Agricultural Land Use - Agricultural baseline data will be gathered during both preconstruction and construction phases of the project. These data will be obtained for the 1,940-acre plant site and surrounding area, as well as along transmission line rights of way. Data collected will include soil types of the site and general area, acreages of various kinds of crops onsite and within a 5-mile radius, and estimates of the numbers of livestock within the site and also within a 5-mile radius.

6.1.4.2 Noise Levels - Ambient noise will be monitored at site boundaries, selected community locations, and possibly at selected locations associated with construction of power transmission systems. Sampling will be performed daily for periods of time sufficient to reflect daytime and nighttime noise levels.

Monitoring will continue throughout the construction period in order to demonstrate and minimize if practical noise impacts from various construction phases and to show noise levels as a function of diurnal and seasonal changes.

6.1.5 Radiological Surveys - The objective of the preconstruction-construction environmental radiological monitoring program is to establish the distribution of natural and man-made radioactivity in the environment near the plant site prior to and during construction of the plant. Construction activities in the Cumberland River will disturb the existing bottom sediment, resuspending part of it in the river. The purpose of this monitoring program is to determine the effect of these construction activities on the reservoir.

6.2 Proposed Operational Monitoring Programs

6.2.1 Radiological Monitoring

6.2.1.1 Plant Effluent Monitoring - The Hartsville Nuclear Power Plant process and effluent radiation monitoring system will continuously monitor and record the radioactivity of all liquid and gaseous effluent streams which release or have the potential of releasing radioactivity to the environment. Sampling and laboratory analysis will be used to identify the type and quantity of radionuclides and establish the typical effluent mix. This information will be used to compute total release to the environment.

6.2.1.2 Environmental Radiological Monitoring - The program will include measurements of direct gamma radiation and sampling of airborne radioactivity, fallout particulate matter, rainfall, well and public water supplies, soil, vegetation, milk, fish, clams, bottom sediment, plankton, and river water. It will be continually evaluated to determine that the most sensitive vectors are being sampled.

At present it is felt that this program will sample those vectors which will give the first indication of increased radioactivity levels in the environment. If statistically significant increases above natural preoperational background are seen in those vectors being sampled, consideration will then be given to expanding the sampling program to include other parameters.

6.2.2 Chemical Effluent Monitoring - The onsite chemical effluent monitoring program for the plant is designed to meet applicable state and/or Federal requirements. Effluents from the plant discharge system and the yard drainage ponds will be monitored for chemical constituents. Additional monitoring may be provided as required to meet future applicable regulations.

6.2.3 Thermal Effluent Monitoring - The operational monitoring program will have as its foundation the nonradiological technical specifications. These specifications will be based on the information gathered during the preconstruction stage of the monitoring program. Based upon acquired data, some parameters or even sampling stations may be deleted.

Conversely, information gained in the future may indicate the need for additional parameters or stations.

A detailed thermal monitoring program will be available at the time of application for an operating license.

6.2.4 Meteorological Monitoring - The principal objectives discussed in Section 6.1.3 for the preconstruction and construction phases are similar to those identified with the operational phase. However, the rationale for the operational phase is somewhat different as the monitoring program will be designed to identify the environmental impacts from cooling tower operations based on actual field measurements. Also, continuous monitoring of atmospheric dispersion conditions will be made in support of the radiological monitoring of gaseous radioactive emissions.

The models used to estimate cooling tower plume lengths and the occurrence of river fogging from blowdown discharge will be verified and upgraded. Similarly, the occurrence of related fogging and icing will be monitored. Other plume related effects will be studied. Special attention will be given to providing the necessary meteorological support for evaluating the effects of cooling tower effluent releases on air and soil moisture, plant growth, and other possible impacts on the plant site ecology.

6.2.5 Ecological Monitoring

6.2.5.1 Water Quality and Limnology - The operational monitoring program will have as its foundation the nonradiological technical specifications for the Hartsville Nuclear Plant. These specifications will be based on the information gathered during the preconstruction stage of the monitoring program. The limnological and water quality parameters will probably remain closely adherent to those listed in the construction phase. Based upon acquired data, some parameters or even sampling stations may be deleted. Conversely, information gained in the future may indicate the need for additional parameters or stations.

6.2.5.2 Fish Monitoring - Operation of the plant will result in three main categories of nonradiological impact on fish: heated water discharges, impingement of fish on trash-collecting screens, and entrainment of fish. Most of the monitoring will be done in the area very near the plant, where any impacts should be most pronounced. No reservoir-wide monitoring is contemplated.

6.2.5.3 Terrestrial Monitoring - The monitoring programs for assessing terrestrial impacts of plant operation are essentially a continuation of the preconstruction and construction studies. They include the documentation of changes in agricultural land use and, in particular, potential cooling tower drift-related consequences.

If unique or threatened species and habitats are discovered on the on-site or off-site impact areas (transmission corridors, railroad access), additional monitoring programs will be developed.

Transmission line rights of way will be monitored for long-term land use changes. Aerial photography or high altitude infra-red photography

will be used to make observations and to detect such effects as excessively eroded agricultural lands. General changes in land use patterns may also be monitored utilizing these techniques.

6.2.5.4 Noise Monitoring - Operational noise impacts may occur from some plant sources, such as pressure relief valves, circuit breakers, transformers, motors, fans, cooling towers, and rail traffic. Noise will be monitored at site boundaries and at selected points in the community.

REFERENCES FOR CHAPTER 6

1. "Handbook of Standard Procedures for the Collection of Water Samples," Tennessee Valley Authority Division of Environmental Planning Internal Report I-WQ-74-1, February 1974.

2. "Standard Operating Procedures for Routine Limnological Activities," Tennessee Valley Authority Division of Environmental Planning Internal Report I-EB-74-3, in preparation.

3. "Guidelines: Biological Surveys at Proposed Heated Discharge Sites," Environmental Protection Agency.

4. Population by County, Historic (1940-1970) and Projected (1980-2020), Environmental Protection Agency, Region IV, Atlanta, Georgia, 1972.

7.1 Plant Accidents Involving Radioactive Materials

A high degree of protection against the occurrence of postulated accidents in the Hartsville Nuclear Plant will be provided through correct design, manufacture, and operation, and the quality assurance program used to establish the necessary high integrity of the reactor system. Deviations that may occur will be handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, even though they may be extremely unlikely, and engineered safety features will be installed to mitigate the consequences of those postulated events which are judged credible.

In the safety analysis report which TVA has submitted in accordance with AEC requirements, postulated accidents are evaluated using extremely conservative assumptions. This safety analysis shows that the calculated doses resulting from postulated accidents of great severity analyzed using highly conservative assumptions will be less than the 10 C.F.R. Part 100 requirements which ensure the public health and safety during accident conditions.

For the purpose of the potential for environmental impact, however, the probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using best estimates of probabilities and realistic fission product release and transport assumptions. This approach to the analyses is therefore different from that used in safety analysis reports where conservative values are used to establish limits for design bases. The realistically computed doses that would be received by the population are thus significantly less than those presented in the safety analysis.

Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious were identified by the AEC. In general, accidents with a high potential for adverse effects have a low occurence rate and those with a low potential for adverse effects have a somewhat higher occurrence rate. The examples selected for these classes are shown in Table 7-1. These examples are reasonably homogeneous in terms of probability within each class.

TVA's estimation of the doses which might be received by an assumed individual standing at the site boundary in the downwind direction, using standard assumptions is presented in Table 7-2. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table 7-2. The man-rem estimate was based on the projected population within 50 miles of the site for the year 2020.

More detailed information concerning accident analysis can be found in the Hartsville Nuclear Plant Environmental Report and Preliminary Safety Analysis Report.

The calculated doses are based on airborne transport of radioactive materials resulting in both a direct and an inhalation dose. It is expected that the environmental monitoring program and appropriate additional monitoring (which could be initiated subsequent to a release incident detected by in-plant monitoring) would detect the presence of any consequential amount of radioactivity in the environment in a timely manner such that remedial action could be taken if necessary to limit exposure via other potential pathways to man.

To rigorously establish a realistic annual risk, the calculated doses in Table 7-2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurences which are anticipated during plant operations; their consequences, which are very small, are considered within the framework of routine effluents from the plant and are discussed in Sections 3.5 and 5.3. The remaining classes of accidents are not expected to occur during the life of the plant with the probability decreasing as the degree of severity of the accidents increases. Therefore, when the consequences indicated in Table 7-2 are weighed by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design bases of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is judged so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain a high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

Table 7-2 indicates the realistically estimated radiological consequences of the postulated accidents which would result in exposures of an assumed individual at the site boundary. The table also shows for each postulated accident the estimated integrated exposure of the population within 50 miles of the plant. When considered with the probability of occurrence, the annual potential radiation exposure of the population from each postulated accident is only a fraction of the annual exposure from natural background radiation. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small.

7.2 Accidents During Transportation

7.2.1 New Fuel - The problems which might result from a transportation accident equivalent to that specified in 10 C.F.R. Part 71 would consist of the physical damage of the impact and the interference and delay associated with having to send the fuel back to the fabricator for inspection. A subsequent determination would then be made to determine whether there had been damage which would affect the operation of the fuel in the reactor. There would be no release of radioactive materials and no increase in radiation dose rates over those from normal shipment. Thus, it is concluded that there would be no significant environmental risks resulting from an accident involving a shipment of new fuel.

7.2.2 Spent Fuel - The principal potential environmental effects resulting from an accident involving spent fuel shipment would be the radiation doses, resulting from the increased radiation levels, from the gaseous release of iodine and noble gases, and from the release of contaminated coolant. The dose from direct radiation was calculated using AEC assumptions[1,2]. Evaluation of exposure from direct radiation assumes that the radiation exposure rate is the maximum permitted by regulations, 1,000 mrem/h at 3 feet from the surface of the container. If a person remained 50 feet from the container for 2 hours, his exposure would be about 34 mrem. The increased radiation level would most likely be from only a localized area on the container, and thus only a small number of people would likely be exposed to these radiation levels.

Because of the dose reduction with distance and the mitigating effect of proposed emergency actions, it can be concluded that the whole-body radiation exposure to the public would be negligible.

Calculations for a probable shipping container indicate that there would be no gaseous releases unless there were a substantial quantity of decay heat in the shipping container and some additional external heat such as from a fire. It is believed that due to the unlikely combination of circumstances which must be present; the probability of having an accident resulting in the release of noble gas and iodine is about 8×10^{-3} per million miles traveled.[2] Based on this and a conservatively assumed mileage for spent fuel shipment, it is projected that the probability that an accident of this nature would occur during the plant life is about .045. For overweight shipments by truck or shipments by rail, both of which would reduce the total number of shipments, the probability would be much less. Despite this low probability of occurrence, potential doses resulting from such an accident have been calculated. It is assumed that the heated air currents surrounding the container would carry any released fission gases to a height of 10 meters before they are dispersed in the environment. Assuming a person stands in the plume during the entire accident, the resulting whole body exposure would be 2 mrem, the skin dose would be about 86 mrem, and the thyroid dose would be about 5 rem.

When the doses which have been calculated are considered along with the low probability of occurrence of the set of circumstances which would result in these doses, it is felt that the environmental risk is extremely small.

7.2.3 Radioactive Waste - All radioactive wastes which will be shipped from the plant will be much lower in levels of radiation and in concentration of radioactive material than the spent fuel previously discussed. The type of packaging used will depend upon the type of waste and its activity level and will comply with AEC and Department of Transportation regulations. These packages are designed and constructed in such a manner that in the unlikely event of an accident there is a very low probability that the radioactive material would be released.

Soft solid wastes such as paper, contaminated clothing, and rags compacted and placed in drums are typical low specific activity packages of

solid waste. Each may contain as much as 1 curie of activation and fission products distributed throughout about 300 pounds of waste.[2]

The casks which will be used to haul cleanup sludge, spent resins, filter sludge and concentrated wastes will, as a minimum, be qualified Type B packages licensed by AEC. The expected activity per package will be well below that discussed in the AEC publication Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants (WASH-1238) for a 55-gallon drum. In addition, the cask will be of better construction than the 55-gallon drum. Even if the material were released, most of the radioactivity is tightly bound in the solid waste and there is no ready dispersal mechanism.

The probability of an accident involving a shipment of radwaste is small. The package design and construction coupled with the radioactivity levels and form of the waste make a release in the event of an accident unlikely. In the unlikely event some release does occur, the small amount of radioactivity and the fact that it is bound in a solid form combine to make the probability of serious radiation doses quite small. For the above reasons, TVA considers that the environmental risk from the transportation of solid radioactive waste is small.

7.3 Accidents Involving Nonradioactive Materials

Oils, chemicals, and other materials will be transported to and from the proposed plant and will be stored on site in various areas. The accidental release of these to the environment could cause adverse effects.

The probability of accidental releases from any cause will be minimized by proper design of storage and handling facilities, operator surveillance, attendance of personnel during operations, and written instructions. TVA is presently preparing a general "Oil and Hazardous Materials Contingency Plan" for all TVA facilities as required by both Executive Order and Federal legislation. As part of this plan a separate "Spill Prevention, Control, and Countermeasure Plan" will be prepared for each individual facility, including the Hartsville Nuclear Plant. The storage of hazardous liquids at the plant will be kept to a minimum consistent with maintaining plant reliability.

It is concluded that the use of multiple storage tanks and collection sumps and the use of retention basins and limestone beds reduces the risks to the environment associated with storage of potentially hazardous materials to the minimum practicable level.

All potentially harmful chemicals and other materials will be shipped to Hartsville by rail or by truck under applicable ICC and state highway regulations.

References for Chapter 7

1. General Packaging and Shipment Requirements, Department of Transportation Regulations (49 C.F.R.), Regulations Section 173.393.

2. Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants, USAEC Report, WASH-1238, December 1972.

Table 7-1

Classification of Postulated Accidents and Occurrences

Class	General Description	Specific Accidents and Occurrences Analyzed
1	Trivial incidents	Spills and leaks inside containment
2	Small releases outside containment	Spills, leaks, and pipe breaks outside containment
3	Radioactive waste system failure	1. Equipment leakage or malfunction (includes operator error) 2. Release of waste gas storage tank contents 3. Release of liquid waste storage tank contents
4	Release of fission products to primary system (BWR)	1. Fuel cladding defects 2. Off-design transients that induce fuel failures above those expected
5	Fission products released to primary and secondary systems (PWR)	This class of accidents is not applicable to the Hartsville Nuclear Plant because it is a BWR
6	Refueling Accidents	1. Fuel bundle drop 2. Heavy object drop onto fuel in core
7	Spent fuel handling accidents	1. Fuel assembly drop in fuel storage pool 2. Heavy object drop onto fuel rack 3. Fuel cask drop
8	Accident initiation events considered in design basis evaluation in safety analysis report	1. Loss of coolant accidents (a) small pipe break (b) large pipe break (c) instrument line break 2. (a) control rod ejection accident (PWR). This accident is not applicable to Hartsville Nuclear Plant because it is a BWR (b) control rod drop accident (BWR) 3. (a) Steamline breaks (PWR) - This accident is not applicable to Hartsville Nuclear Plant because it is a BWR (b) Steamline breaks (BWR) - (1) small pipe break (2) large pipe break

Table 7-1 (continued)

9	Hypothetical sequence of failures more severe than Class 8	Accidents of Class 9 are so improbable that they are not considered in this analysis

TABLE 7-2

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

Classification of Event	Description of Event	Individual Doses at Site Boundary (rem): Whole Body	Skin[2]	Total Child[3] Thyroid	Dose Commitment to Population[1] (man-rem): Whole Body	Total Adult Thyroid[3]
1	Trivial incidents	*	*	*	*	*
2	Small release outside containment	*	*	*	*	*
3.1	Radioactive waste leakage or malfunction	1.2 (-4)**	2.3 (-4)	3.4 (-4)	2.1 (0)	3.5 (0)
3.2	Release of waste gas storage tank contents	1.1 (-3)	2.1 (-3)	2.9 (-3)	1.8 (1)	2.9 (1)
3.3	Release of liquid storage tank contents	3.9 (-4)	4.7 (-4)	9.5 (-2)	6.5 (0)	5.9 (2)
4.1	Fuel cladding defects	*	*	*	*	*
4.2	Off-design transients	4.0 (-3)	6.5 (-3)	7.3 (-3)	5.6 (1)	7.4 (1)
5	Releases to primary and secondary systems (PWR)	NA	NA	NA	NA	NA
6.1	Fuel bundle drop	5.5 (-5)	1.8 (-4)	1.4 (-4)	9.2 (-1)	1.5 (0)
6.2	Heavy object drop onto fuel in core	6.4 (-4)	2.0 (-3)	1.6 (-3)	1.1 (1)	1.7 (1)
7.1	Fuel assembly drop in fuel storage pool	5.5 (-5)	1.8 (-4)	1.4 (-4)	9.2 (-1)	1.5 (0)
7.2	Heavy object drop onto fuel rack	2.2 (-5)	9.6 (-5)	1.2 (-4)	3.6 (-1)	9.6 (-1)
7.3	Fuel cask drop[4]	2.4 (-7)	2.6 (-5)	2.4 (-7)	4.0 (-3)	4.0 (-3)
8.1(1)	Small pipe break	7.4 (-8)	1.2 (-7)	2.6 (-6)	1.2 (-3)	1.2 (-2)
8.1(2)	Large pipe break	2.4 (-3)	5.3 (-3)	1.0 (-1)	3.3 (1)	4.4 (2)
8.1(a)	Instrument line break	NA	NA	NA	NA	NA
8.2(a)	Control rod ejection accident (PWR)	NA	NA	NA	NA	NA
8.2(b)	Control rod drop accident (BWR)	5.0 (-3)	8.1 (-3)	9.1 (-3)	7.0 (1)	9.3 (1)
8.3(a)	Steamline break (PWR)	NA	NA	NA	NA	NA
8.3(b)(1)	Small steamline break (BWR)	5.4 (-6)	8.3 (-6)	2.9 (-4)	9.0 (-2)	1.8 (0)
8.3(b)(2)	Large steamline break (BWR)	1.2 (-4)	1.7 (-7)	1.8 (-2)	2.0 (0)	1.1 (2)

NA - Not applicable
* - Evaluated as routine release
** - 1.2 (-4) = 1.2×10^{-4}

1. Based on estimated 2020 population within 50 miles of plant
2. External beta plus gamma dose
3. External gamma dose plus iodine inhalation dose
4. Based on one fuel assembly per cask

8.0 Economic and Social Effects of Plant Construction and Operation

This section provides an overall assessment of the economic and social benefits and costs of the Hartsville Nuclear Plant.

TVA from its very inception has been deeply committed to the tasks of environmental improvement. The President in transmitting to Congress in 1933 the bill that became the TVA Act said that TVA "...should be charged with the broadest duty of planning for the proper use, conservation, and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general social and economic welfare of the Nation." It is on the basis of these principles that TVA plans and conducts all its activities, be they planning, constructing, and operating a nuclear power plant; planning, building, and operating a water control project; providing research to develop a new fertilizer; setting aside areas for fish and wildlife; developing improved hardwood tree strains; or seeking ways to utilize the rugged scenic qualities of some of the region's natural streams. In all of these and many other varied resource development programs, TVA is deeply conscious of its responsibilities to the people in the TVA region and in the Nation. This posture invariably calls for a balancing of a variety of interests and, finally, decision and action in which differences are reconciled insofar as possible to best serve the needs of the greatest number over the longest possible time. Inherent in this is the requirement of finding a balance between the needs of the man, including his need for useful employment, and the safeguarding of his physical environment.

In TVA electric power is regarded as a tool for economic development. Its use has been encouraged as a means for improving the quality of life in the region. Fitted into a comprehensive, unified development program, it has helped ease the burdens of drudgery; provided more jobs and more productive employment; brought the amenities of life to an ever-increasing number of people; and generally improved the health, education, and living conditions of the people.

An ample supply of low-cost electric energy, integrated with a total resource development program, has been a major factor in the progress achieved by the TVA region since 1933. Employment, income, and productivity have all increased with a shift from a primarily agricultural to an industrial economy.

The uses of electricity are many. To the residential user it provides lighting, refrigeration, cooking, washing and drying of clothes, heating, air conditioning, and education and entertainment via radio and television, to name but a few. Most stores, banks, and other commercial ventures are dependent on electricity for conducting business. In industry it is an essential element by which productivity has been increased with an attendant improvement in living standards. While in most industrial activities the cost of electric power is a small fraction of the total cost of production, without electricity modern industry could not provide the Nation with the goods and services it demands. In the aluminum, electrochemical, and metallurgical industries, electricity is a significant component required in the manufacture of these essential products.

The addition of the Hartsville Nuclear Plant to the TVA system will enable TVA to continue to carry out its responsibility to provide an ample supply of electricity for the TVA region. The benefits of the plant include the value of the electrical power to be generated, including a stimulation of the economic growth of the region, helping to assure increased employment potentials; the potential for reduction of releases of combustion products to the atmosphere which would be associated with fossil-fired generation; the recreational and educational value to visitors to the plant; and increased payments to local governments in lieu of tax payments.

Discussions of the socio-economic benefits and costs for this facility are given in Sections 8.1 and 8.2 and summarized in Chapter 11. The weighing and balancing of benefits and costs of alternative generation, sites, and subsystems is presented in Chapters 9 and 10.

In addition to analyzing the need for baseload electrical capacity additions, the Hartsville Nuclear Plant environmental review includes an analysis of the alternatives for limiting environmental impacts during the construction of the project and the environmental impacts which will result from operation of the plant. During this environmental review, the design concepts for the plant have been chosen so as to provide a plant which approaches a minimum impact plant. Specific system design concepts are discussed in Chapter 10.

8.1 Benefits

The benefits of the Hartsville plant are detailed below and are summarized in Table 8-1.

8.1.1 Electric Power Produced and Sold - Included in this section are the benefits inherent in the value of the electricity generated by the plant even though the dollar value presented does not provide an exact measure of the benefits due to generation of this power.[1] The Hartsville Nuclear Plant includes four units, with a total dependable capacity of 4,820 MW electrical. The four units are scheduled for commercial operation on the following dates: the first unit in December 1980; the second unit in June 1981; the third unit in December 1981; and the fourth unit in June 1982. Since capacity is planned for on a system basis, it is not possible to identify the specific loads which the Hartsville nuclear units will serve. For the purpose of the benefit analysis, it has been assumed that the plant serves loads based on the incremental increase in loads for each class of customers estimated between fiscal year 1973 and fiscal year 1981. The estimated peak load and sales for these years are identified in the following table.

	F.Y. 1973		F.Y. 1981		Increase	
	Actual Load	Percent of Total	Estimated Load	Percent of Total	Load	Percent of Total
Peak Demand (MW)	18,888	-	31,300	-		-
Estimated Sales (Million kWh):						
Residential	30,637	29.6	48,302	27.7	17,665	25.0
Commercial	12,908	12.5	23,959	13.7	11,051	15.6
Industrial	37,085	35.8	63,906	36.7	26,821	37.8
Government	18,259	17.7	30,262	17.4	12,003	17.0
Other Sales	4,584	4.4	7,816	4.5	3,232	4.6
Total Sales	103,473	(100)	174,245	(100)	70,772	(100)

The value of a unit of electric energy to the user varies widely, depending on the availability and cost of alternative energy sources. No attempt is made to identify such values in this analysis. However, the price customers now pay for electric energy establishes a measure of the value to the user. Based on the present rate structures of TVA and the distributors of TVA power, the following average prices to the ultimate consumer are estimated.

Residential	1.519¢/kWh
Commercial	1.421¢/kWh
Industrial	0.933¢/kWh
Government	0.788¢/kWh
Other	1.276¢/kWh

For the purpose of estimating the present value of the revenue received from the sale of this energy, it has been assumed that the Hartsville plant will operate as shown in the following table during its 35-year generating life.

Years	Capacity Factor	Annual Net Generation (Million kWh)	Total Transmission and Distribution Losses (Million kWh)	Annual Energy Available For Sale (Million kWh)
1-15	80%	33,778	2,287	31,491
16-25	55%	23,223	1,572	21,651
26-35	40%	16,889	1,143	15,746

Using the energy available for sale and the current prices paid for electricity shown above, a discount rate of 8 percent, and the assumption that all units operate for the same time period, a value of the sales from the plant is estimated and presented in the benefit description form. The results are summarized below.

Levelized Annual Energy Generation (kWh)	$30{,}440 \times 10^6$
Levelized Total Annual Losses (kWh)	$2{,}061 \times 10^6$
Levelized Annual Energy Available for Sale (kWh)	$28{,}379 \times 10^6$

	Average Annual Energy Available For Sale - kWh	Value of Sales During Plant Life 1981 Dollars	Average Annual Value - Dollars
Energy Sold:			
Residential	$7{,}095 \times 10^6$	1,256,000,000	107,800,000
Commercial	$4{,}427 \times 10^6$	733,000,000	62,900,000
Industrial	$10{,}727 \times 10^6$	1,166,000,000	100,100,000
Government	$4{,}825 \times 10^6$	443,000,000	38,000,000
Other	$1{,}305 \times 10^6$	195,000,000	16,700,000
Total Sold	$28{,}379 \times 10^6$	3,793,000,000	325,500,000

Historically, electricity rates declined until the mid-1960's. Events of more recent years have caused this trend to reverse. Higher prices for fuels, higher interest rates, increases in construction costs, and costs of pollution control equipment have been significant factors causing the increases in rates for electric utilities. It was necessary for TVA to increase its rate schedules in 1967, 1969, 1970, 1973, and 1974. The effect of these rate increases has resulted in the average cost of electricity to the consumer increasing by 85.9 percent. Thus, the use of current rates throughout projected plant life could significantly understate the future sale price.

8.1.2 Payments in Lieu of Taxes - Estimates of payments in lieu of taxes include estimates of payments to state and local governments by TVA and by distributors of TVA electricity. Estimates are based on current rates of payment related to the energy which will be generated by the plant. An estimated \$14.4 million will be paid to the State of Tennessee.

TVA acquisition of the site land and construction of the nuclear plant will not have any effect upon TVA payments in lieu of taxes directly to the counties concerned under the provisions of Section 13 of the TVA Act as amended. The value of the generating plant site immediately upon acquisition and the book value of the plant itself as construction proceeds will be reflected in the calculation formula which determines the amount of the annual payment in lieu of taxes from TVA to Tennessee state government.

Under state law, TCA Sections 67-2401--2405, as amended, the state of Tennessee redistributes to counties and municipalities a portion of the TVA payment received by it. As now interpreted and administered, the state redistribution procedures provide for payments to local units based on the land only used for TVA generating plant sites. Such annual calculation calls for application of the utility assessment ratio (55 percent) to the TVA purchase cost of the generating plant site and then applying the current local property tax rate to the hypothetical assessment so derived to determine the amount of the state redistribution payment to the local unit. Such state calculations will take effect with respect to the first fiscal year beginning after official TVA designation of the land as a generating plant site. Since the land is now classed as farm land subject to an assessment ratio of 25 percent, and the TVA purchase cost will likely be well above the county property assessor's appraised value of the land as farm land, it is clear that the counties can expect a larger payment in lieu of taxes (from the State) because of this plant site than the amount of former farm taxes on the same land before TVA acquisition. The comparative former county taxes and estimated future payments in lieu of taxes to the respective counties for this property are set out in Table 8-2. The estimated future payments in Smith County will be about six times the amount of present taxes on the site land, in Trousdale County over four times, and nearly five times for the two counties combined. The payments in lieu of taxes benefits will go to Smith and Trousdale Counties and the State of Tennessee.

8.1.3 Regional Gross Product - Benefits of the Hartsville plant to regional gross product cannot be exactly quantified monetarily. However, a correlation has been made of the average annual dollar flow of gross product with the use of the Hartsville electrical power in the TVA power service region. This correlation is based on using the average power generation and relationships between gross product and kilowatt-hours equivalent of all energy consumed. The industrial gross product factor was obtained as a product of the relationship between value added with kWh equivalent (Census of Manufacturers, 1967) and the relationship between gross product from manufacturing and value added by manufacturing (Census of Manufacturers, 1967 and Survey of Current Business). The numerical value of the industrial gross product factor was found by this method to be $0.0649 per kWh. The commercial gross product factor was obtained by comparing gross product from commercial activities and an assumed electrical energy output of 25 percent of total energy input to the commercial sector (Energy in the American Economy, 1850-1975, Schurr and Netschert). Numerical values of this factor were $0.187 per kWh for 1967 and $0.184 per kWh for 1969. Giving slightly more weight to the recent figure, $0.185 per kWh was selected as the commercial gross product factor. Industrial power consumed was assumed to include government use of electrical energy. The resulting average annual dollar flow of gross product is estimated at about $1.828 billion.

As noted above, no additional quantification to arrive at a monetary benefit is considered possible. This is because the comparison of dollar value of products produced and energy consumed does not consider other variables in the production of products, such as wages of workers and efficiencies of individual production processes. It should be noted that a plentiful energy source has long been considered essential in the economic and industrial expansion of any region. As required by the TVA Act, as amended, TVA maintains an ample supply of electrical energy in the area in which it conducts its operations. A comparison of statistics in the TVA region with national statistics implies there are some beneficial effects of this plentiful energy source. In 1960 gross regional product was 2.26 percent of national; in 1970 this had increased to 2.69 percent. In 1960 personal income in the region was 64 percent of the national value; in 1970 this had increased to 75 percent. TVA considers that the ample availability of electricity as an energy source has helped realize these growth rates. This will be a benefit for the entire region in the TVA system, the southeastern U.S., and the Nation.

8.1.4 Recreation - The recreational benefits of the proposed visitors center at the Hartsville site are estimated at 15,000 visits per year. This estimate of recreational visits is in addition to the estimate of educational visits to the plant, which is given in Section 8.1.7. At a value of $0.75 per visit[2], the annual value of these visits is estimated to be $11,000. The persons making the visits to the plant will receive this benefit.

8.1.5 Air Quality - Since the Hartsville plant is a baseload plant, approximately 8.8 billion kWh will be available during the baseload period to replace coal-fired generation which would otherwise have consumed about 4 million tons of coal per year. This will result in annual reductions in particulate emissions of about 3,600 tons, SO_2 emissions of about 235,000 tons, and NO_x emissions of about 36,000 tons. This is based on replacing coal-fired generation using coal of the quality now being burned and current proven emission control technology. This will benefit the people in the TVA area.

8.1.6 Employment - Benefits to employment have been listed as the average annual number of workers whose jobs could be related to the consumption of electrical power produced by the Hartsville plant. An industrial employment factor, relating kWh equivalent consumed in manufacturing to employment in manufacturing, was determined from national data from the Census of Manufacturers, 1967. A value of 5.4588 workers per million kWh was obtained. A commercial employment factor was obtained by analysis of data from Energy in the American Economy, 1850-1975, by Schurr and Netschert. For 1967, this relationship was 14.83 workers per million kWh; for 1969, 13.39 workers per million kWh. The intermediate value of 14 was chosen for estimating the commercial portion of the employment value listed. Based on the portion of the Hartsville Nuclear Plant generation allocated to commercial and industrial use, the potential exists for expanding the number of new jobs by about 146,900. This will affect the entire region in the TVA system. Employment at the project will consist of temporary construction personnel and permanent

plant personnel. The estimated average annual 1974 wage for such a construction force is about $13,300; and the estimated average annual 1974 wage for a member of the plant staff is approximately $13,000. Estimates of total wages which will be paid to the construction force during the construction period is about $373 million. Annual income for the permanent plant staff is estimated to be about $4.5 million. The area that receives this benefit will be the area where the workers and their families live, primarily within commuting distance of the plant site.

8.1.7 Education - The educational benefits of the Hartsville plant are estimated to be 55,000 visits per year after the plant is operational. The annual value of these visits, at $1.90 per visit[3], is $104,500. Educational visits by persons to the plant during its construction are estimated to be about the same number as after the plant is operational. The persons receiving this benefit will be those persons who visit the plant.

As a result of the mitigation program outlined in Section 4.2, some impacted school systems may have permanent facilities with less capital outlay than they would have without the project. This capital contribution by TVA will be equivalent to the necessary expenditures for temporary facilities. The amount will be determined in part by further studies on estimated impacts and part by what impacts are actually experienced.

8.1.8 Aesthetics - As discussed in Section 3.1, the design of the plant will utilize the natural topography of the site, construction material, structure placement, and landscaping to make the plant as attractive as possible to reduce visual impact on the surrounding area.

8.2 Costs

The economic and social costs associated with the Hartsville Nuclear Plant are addressed below in two parts--Internal Costs and External Costs.

8.2.1 Internal Costs - An appraisal of the primary economic costs resulting from facility construction, operation and maintenance, and decommissioning is discussed below and presented in Table 8-3. All cost information is expressed in 1981 dollars, regardless of the year in which the expenditure is made utilizing an escalation rate of 5 percent, an interest rate of 8 percent, and a 35-year life of plant. The escalation rate is based on previous TVA experience with the construction and operation of other steam plants, and the interest rate is an estimate based on TVA financing methods.

The items and their costs that make up the internal cost for this plant are: (1) Capital cost of land acquisition and improvement including costs of relocation and assistance to displaced families. (2) Capital costs of facilities construction. (3) Plant decommissioning costs (a discussion of decommissioning is contained in Section 5.9).

(4) Capital costs of plant's distribution and transmission facilities. (a) Distribution facilities (this cost is also contained in the capital cost of facilities construction). (b) Transmission facilities. (5) Present worth fuel costs. These costs include fees for disposition and reprocessing the spent fuel, as well as credits for recovered plutonium and uranium. (6) Operating and maintenance costs. These costs do not include payments in lieu of taxes or other annual fees. (7) Fees. (a) Application fee. This will be paid in 1974. (b) Construction permit fee. This will be paid in 1975. (c) Operating license fee. This is assumed to be paid in 1981 for all units. (d) Present worth annual fees. (e) Present worth estimated payments in lieu of taxes. The total present worth generating cost is $3,081,629,000.

8.2.2 External Costs - The external costs are those social and economic costs resulting from construction and operating the proposed plant.

While various benefits and costs have been quantified, some are necessarily expressed in qualitative terms. Of those factors subject to quantification, all cannot reasonably be expressed in monetary values; therefore, environmental and social costs are, for the most part, quantified in commonly used units such as numbers of fish, gallons of water, and tons of earth.

8.2.2.1 External Costs (Construction Related) - The temporary external costs are primarily those related to construction and are not expected to last past the end of construction and a short readjustment period thereafter. An indication of these costs is given below and discussed in Section 4.2.

Employment at the project will range from approximately 2,100 employees after the first year to a peak of about 5,000 after the fourth year. Of these employees, those moving into the vicinity of the Hartsville project are estimated to be about 550 after the first year and about 2,700 at the peak of employment. The total population and school-age population increase associated with these employee movers is estimated to be 6,100 and 1,700, respectively, at the peak of employment.

Housing - As discussed in Section 4.2, the influx of construction workers will stress the available housing market and potentially create localized land use conflict in the area of the plant. During peak employment, the housing demand is estimated to be for about 2,000 dwelling units. Based on past experience, mobile homes may comprise one-half or more of the housing occupied by construction workers, or about 1,000 at peak. This would leave a demand of 1,000 conventional dwelling units. The conventional housing needs are expected to be met primarily in Wilson and Sumner counties (See Section 4.2). Most mobile homes are expected to locate in close proximity to the site in Smith, Trousdale, and Macon counties.

Traffic - State Highway 25 had an average daily traffic (ADT) load of about 2,100 vehicles in 1972. The capacity of this type road ranges from about 3,500 to about 5,000 ADT. Peak construction traffic would add about 2,600 to the ADT which may result in a temporary overload condition from an ADT standpoint. From an hourly standpoint, this type of road can accommodate from 1,150 to 2,000 cars per hour. Therefore, the highway is likely to be able to accommodate the estimated 1,500 cars associated with the change of the day shift, particularly since the construction traffic from the site will be divided between the east and west directions on the highway. An access road will be available at each end of the site, which should reduce traffic conflicts. However, there will be some congestion in the towns of Hartsville to the west and Carthage to the east of the site since some workers will commute from beyond these towns and must pass through them.

Health Facilities - In May 1973, only one physician was practicing in Trousdale County and six in Smith County. Three small, unaccredited hospitals serve the area; the Hartsville General Hospital with 34 beds; the Carthage General Hospital with 29 beds; and the Smith County Hospital with 43 beds, one coronary care unit, and one intensive care unit. Emergency Medical Services (EMS) are being improved in Trousdale County as part of a program of the Mid-Cumberland Health Planning Agency.

Relocation - Eleven households on the site and two in the path of the proposed access railroad will need to be relocated. As discussed in Section 4.2, these families are entitled to certain assistance.

8.2.2.2 External Costs (Operation Related) - These costs are those social and economic costs that will be associated with the operation of the Hartsville Nuclear Plant.

Location of the plant, because of its size, will change the aesthetic and scenic values in the immediate vicinity of the plant. A discussion of these values and composite drawings are contained in Section 3.1 of the environmental report.

The proposed use of the site will result in the removal of most of the 1,940 acres contained within the site from active farming. Based on 1972 prices, the estimated annual value of agricultural production at the site during the past five years has been approximately $260,000. Land occupied by the plant structure may be committed beyond the life of the plant. A discussion of these changes is contained in Section 5.8.

About 5,400 acres of land will be affected in that its use under easement agreements will be restricted to those uses not interfering with transmission line operation and maintenance. Multiple uses of rights of way are discussed in Section 5.5. The 2,311 acres of the rights of way now in forest must be considered to be removed from forest production.

The access railroad will require about 75 acres of land. This land will be removed from its present use for at least the life of the plant.

Operation of the natural draft cooling towers will result in a water vapor plume that would normally be visible over a wide area. This should create no impacts offsite other than visual. However, fog resulting from the small amount of heated discharge into the river will affect river traffic for approximately 497 hours per year.

Costs to local governments for increased services for the permanent employees have not yet been quantified.

Environmental impacts may also have socio-economic implications such as some loss of aquatic and terrestrial organisms due to plant construction and operation. These effects are discussed in Chapters 4 and 5.

REFERENCES FOR CHAPTER 8

1. Vermont Yankee Nuclear Power Corporation (Vermont Yankee Nuclear Power Station), ALAB-179, RAI 74-2, 172-76 (February 28, 1974).

2. "Establishment of Principles and Standards for Planning Water and Related Land Resources," Water Resources Council, October 25, 1973.

3. Calculations based on "State of Tennessee, Annual Statistical Report of the Department of Education for the Scholastic Year Ending June 30, 1973."

TABLE 8-1

HARTSVILLE NUCLEAR PLANTS - BENEFITS

Direct Benefits	
Expected Levelized Annual Generation in Kilowatthours	30,440,000,000
Dependable Capacity in Kilowatts	4,820,000
Proportional Distribution of Electrical Energy - Expected Levelized Annual Delivery in Kilowatthours:	
Residential	7,095,000,000
Commercial	4,427,000,000
Industrial	10,727,000,000
Government	4,825,000,000
Other	1,305,000,000
Annual Revenues from Electrical Energy Generated in Dollars	
Residential	107,800,000
Commercial	62,900,000
Industrial	100,100,000
Government	38,000,000
Other	16,700,000
Indirect Benefits	
In Lieu of Tax Payments (Local, State), Dollars/Year	14,400,000
Regional Product	(See Text)
Environmental Enhancement	
Recreational	
Visitors' Center, Dollars/Year	11,000
Air Quality (Potential to Reduce Pollutants in Tons/Yr)	
SO_2	235,000
NO_x	36,000
Particulates	3,600
Employment	
Potential Jobs Provided	146,900
Total Income by Construction Force, Dollars	373,000,000
Annual Income by Permanent Plant Personnel, Dollars	4,580,000
Education, Dollars/Year	104,500

TABLE 8-2

HARTSVILLE NUCLEAR PLANTS
FORMER COUNTY TAXES ON LAND COMPARED WITH ESTIMATED
FUTURE PAYMENTS IN LIEU OF TAXES

Explanation	Smith County	Trousdale County	Total 2 Counties
Assessed valuation of land (25% assessment ratio)	$ 40,205	$117,283	$ 157,488
Tax rate per $100, 1973	2.85	2.15	-
Amount of county taxes, 1973	$ 1,146	$ 2,522	$ 3,668
TVA appraised value of property	$438,064	$910,936	$1,349,000
Estimated in-lieu-tax base (55% assessment ratio)	$240,935	$501,015	$ 741,950
Assumed tax rate (same as 1973)	2.85	2.15	-
Estimated in-lieu-tax payment distributed to counties by state	$ 6,867	$ 10,772	$ 17,639
Excess of in-lieu payment over former taxes	$ 5,721	$ 8,250	$ 13,971

TABLE 8-3

HARTSVILLE NUCLEAR PLANTS
INTERNAL COSTS
(1981 Dollars)

Type of Cost	Cost
Capital Cost of Land Acquisition and Improvement	$ 3,000,000
Capital Cost of Facilities Construction	1,572,000,000
Plant Decommissioning Costs*	125,000,000
Capital Cost of Plants Distribution and Transmission Facilities	
Plants Distribution Facilities*	58,000,000
Transmission Facilities	104,586,000
Present Worth Fuel Costs*	781,421,000
Present Worth Operating and Maintenance Costs*	281,467,000
Fees	
Application Fee*	214,000
Construction Permit Fee*	2,217,000
Operating License Fee*	3,730,000
Present Worth Annual Fees	28,636,000
Present Worth Estimated Payments in Lieu of Taxes	164,328,000

*See text, section 8.2.1.

9.1 Alternatives Not Requiring The Creation of New Generating Capacity

9.1.1 No Action - As discussed in section 1.3, the power supply situation is expected to be extremely tight during the 1980-1982 period even with the planned addition of the Hartsville generating units. Any delay in the operation of these units or a decision not to plan for the forecast increase in power demands could result in the inability of the TVA system to adequately meet its load obligation and could jeopardize the reliability of the system and indeed the region.

Also, a decision at this time not to commit to serve these power demands would preclude the consideration of nuclear generation as an alternative for the 1980-82 period because of the long lead time requirements. As is discussed later in this chapter, nuclear generation offers substantial benefits from both the standpoint of economics and environmental impacts.

The alternative of taking no action to serve the power needs of the area is therefore considered an unacceptable alternative.

9.1.2 Conservation - TVA began conservation programs in 1971 emphasizing the benefits in energy savings. Although it is difficult to separate the conservation effect from other factors during the winter of 1973-74, the effect appears to be significant. TVA estimates the effect of the conservation effect will amount to about 2300 megawatts or about 7 percent in the winter of 1982-83. Offsetting this somewhat is the effect of substitution of electricity for scarce fuels which is estimated to add approximately 5 percent to the electric load in that year. In addition, because of the energy shortages, not only in our region, but in all regions, a surge is being experienced in industrial development. TVA estimates that the effects on load caused by substitution of electricity for other energy sources and increased industrial development will more than offset the reductions which can be achieved through conservation. Therefore, conservation is not considered to be a feasible alternative.

9.1.3 Purchased Power - The power demand and supply situation of neighboring utilities has been reviewed as given in FPC Region IV Reliability Council reports, and it has been concluded that the magnitude of TVA's power demands in the early 1980's could not be supplied by purchased power from neighboring utilities with their currently planned capacity additions. Furthermore, to supply equivalent amounts of power and energy on a year-round basis to TVA, another large electric utility with extensive transmission interconnections would have to install generating capacity in amounts slightly greater than that of the Hartsville Nuclear Plant, build several high-capacity transmission lines to the TVA area, and transmit the power to TVA. To construct such facilities on another power system would not avoid an impact on the environment but would only create an environmental impact in another area. Even if the assumption is made that the plant locational factors and costs would be equal, the cost of transmission lines, the transmission line losses, the use of land for transmission line rights of way, and the exposure to transmission line outages would result in waste of

natural resources, materials, and funds, and would provide a more costly and less reliable source of power for the TVA region than will the construction of additional TVA generating facilities. Therefore, the purchase of electric power is considered as an unavailable and unacceptable alternative.

9.1.4 Reactivation of Older TVA Generating Facilities - TVA has no old generating equipment which has been retired with the exception of some very small hydro units which were no longer serviceable. The Watts Bar coal-fired plant which was placed in service in 1942 has been placed in standby condition, but TVA recently reactivated this plant and placed it in active service. This alternative is not available to TVA.

9.1.5 Operating Existing Peaking Capacity as Base Load - Operating TVA's peaking capacity as baseload would generate more kilowatthours during the offpeak periods, but these facilities are already needed to provide an adequate supply during the peak load periods. Thus, this alternative would not provide the required reserve needed in the future nor would it serve the projected increase in power demands and is therefore not feasible.

9.2 Alternatives Requiring The Creation of New Generating Capacity

9.2.0 Introduction - TVA's generation planning studies consider maintaining a practical mix of conventional hydro, pumped-storage hydro, gas turbine, fossil-fired, and nuclear generating units. TVA presently has a large hydro system which supplies an important amount of peaking capacity, and will have a 1,530-MW pumped-storage project (in 1975) and over 1,000 MW of gas turbine peaking capacity on its system before the 1980-1982 generation capacity is needed.

Studies of the system load characteristics and the characteristics of the existing generating facilities indicate that the installation of additional pumped-storage or other peaking capacity is not an economical alternative in the 1980-82 period. The system needs, as indicated by TVA planning studies, required that detailed comparisons be made between baseload alternatives.

9.2.0.1 Baseload Alternatives - The use of hydroelectric units was eliminated as an alternative because there are no hydroelectric sites in the TVA area suitable for baseload hydroelectric generation in the amount required to serve the capacity and energy demands of this time period. Based on the following excerpts from U.S. Geological Survey Circular 647, "Classification of Public Land Valuable for Geothermal Steam and Associated Geothermal Resources," geothermal energy is not considered as a feasible alternative for the TVA area.

> Geothermal areas of the United States are found primarily in the western states, along the circum-Pacific belt of young volcanism and mountain building and where the Pacific ridge system (a locus of high heat flow) intersects the North

> American continent along the Gulf of California and the Imperial-Coachella Valley of California. In the Eastern United States, potentially economic reservoirs of geothermal heat have been identified in the deep parts of the Gulf of Mexico sedimentary basin.
>
> For a geothermal reservoir to have appreciable potential for exploitation, it must meet the following requirements: (1) relatively high temperature (greater than 150°-400° F., depending on processing technology), (2) a depth shallow enough to permit drilling (currently 10,000 ft or less), (3) sufficient rock permeability to allow the heat transfer agent (water and/or steam) to flow continuously at a high rate, and (4) sufficient water recharge to maintain production over many years.

Current estimates of the geothermal gradient in the TVA area are less than 1° C. per 100 feet. On this basis, depth to heated rock would exceed that given above by U.S.G.S. for potential geothermal use. Thus, the potential for geothermal power in the TVA area appears to be very low based on current knowledge of subsurface conditions in the area and certainly could not be relied upon to produce electricity in the quanity and time frame needed.

Thus, TVA's more detailed studies considered that the required generating capacity additions would be baseload fossil-fired, or baseload nuclear units.

9.2.0.2 Alternative Fuels - The assessment of alternative fuels which follows was made prior to the awarding of bids for the Hartsville units in December 1972, and is, therefore based on information which was available at that time.

The Federal Power Commission, numerous speakers before congressional hearings, and private sources continue to forecast national shortages of natural gas in the 1975-90 period. The Federal Power Commission's Bureau of Natural Gas issued a report in February 1972 entitled "National Gas Supply and Demand 1970-1990" which states that the Nation's gas supplies from now until 1990 will be inadequate to meet current projections of future demand. Even with optimistic additions to reserves and substantial imports, the report projects shortages of 9.5, 13.7 and 17.1 trillion cubic feet in 1980, 1985, and 1990, respectively.

Further evidence of the shortage of natural gas was exemplified by Mr. John N. Nassikas' testimony in hearings before the Committee on Interior and Insular Affairs on April 19, 1972, in which he stated:

> In my opinion, it is indisputable, and the evidence so indicates, that deliverable natural gas supplies have deteriorated to intolerable levels. Demand for natural

gas has exceeded the most optimistic forecasts, and environmental considerations will further accelerate the requirements for this clean-burning fuel.

In line with this, TVA has also found a shortage of natural gas in the TVA area. TVA has contacted all major gas suppliers in the TVA area in recent years in hopes of securing a gas supply for 1,000 MW of gas turbines now installed on its system. No gas could be obtained for a year-round supply, and there was only limited success in obtaining a gas supply during the summer months.

In light of the above considerations, generating alternatives which use natural gas as a fuel source are not feasible because of the lack of assurance of a fuel supply.

Oil - The Department of the Interior, in its report, "U.S. Energy - A Summary Review" submitted in January 1972, projected the cumulative 1970-1985 domestic demand for oil at 0.65×10^{18} Btu while the known U.S. reserves are 0.26×10^{18} Btu. The forecast also indicates an increasing dependence on imported oil. Recent estimates by the Department of the Interior indicate that, by 1985, 58 percent of U.S. domestic requirements will be supplied by foreign imports. Rogers C. B. Morton, Secretary of the Interior, before the April 10-13, 1972, hearings before the Committee on Interior and Insular Affairs stated:

> If our domestic resource base is not substantially broadened and improved, then we would look forward to something in the order of 50 percent of our oil requirements being imported.

Of this amount, Mr. Morton said 35 percent of the imported oil would have to come from the Middle Eastern countries.

The country's dependence on imported oil will not be improved by the resolution of the environmental questions associated with the development of offshore reserves and the transportation of oil from Alaska's North Slopes since they are included in the above estimates.

With specific reference to the ability of TVA to be able to assure a fuel supply for a large oil-fired plant, discussions have been held with three suppliers. The suppliers have indicated that the quantity of oil required to supply a plant (the size of the proposed) on a long-term basis would require that the supplier acquire an oil import quota each year. Even if such a quota could be obtained, TVA would be in a position of relying on foreign oil for supplying the energy needs. Serious consideration of oil-fired plants would involve weighing the long-term risks of such a supply, both in terms of the economic factors and the contribution of TVA power supply to the national security, against any identifiable environmental benefits.

Coal - Coal is the most abundant domestic fossil fuel with a conservatively estimated[a] reserve level of 3.2 trillion short tons.

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a. United States Energy - A Summary Review, U. S. Department of the Interior, January 1972, p. 29.

To meet the SO_2 emission standards of Alabama and Tennessee, it is estimated that coal with a sulfur content of 0.7 percent or less would be required. Examination of the Nation's coal reserves meeting this requirement indicates that the vast preponderance of such coal is located in the western states in the form of subbituminous and lignite.

The subbituminous coal of this area is characteristically low-sulfur, high ash and moisture, and low heat content. The transport of this coal to the TVA area would involve distances in excess of 1,000 miles. TVA has conducted tests on an existing coal-fired unit using this coal and has found that there is a substantial loss in capability in units not specifically designed to burn this coal. Discussions with boiler manufacturers in August 1972 indicate that a substantially larger boiler would be required. The largest unit which has been designed to burn low-sulfur coal is about 750 MW.

In consideration of the available reserves, low-sulfur coal is considered as a feasible alternative; however, both the economic and environmental factors associated with the transportation of this coal become significant.

Medium-sulfur coal is available from local sources in the quantities required and at relatively economic prices. However, it is not clear at this point when the SO_2 removal technology will be available to reduce SO_2 emission levels to within prescribed standards when burning this coal.

Uranium - Analysis of recently published reports[b] on projected U.S. demand and reserves that are not reasonably assured indicates that the reserves recoverable at $8 per pound "forward cost" will be depleted in the early 1980's.

In a later report,[c] the AEC estimates the U.S. uranium resources as shown in the table below.

	Tons U_3O_8		
Cost Cutoff $/Lb. U_3O_8	Reserves	Estimated Additional (Potential)	Total
$ 8	273,000	450,000	723,000
$15	520,000	1,000,000	1,520,000

b. Nuclear Industry Fuel Supply Survey, WASH-1196, U.S. AEC, April 1972; and The Uranium Supply Outlook, Short Term and Long Range, S.M. Stoller Corporation, J. F. Hogerton and C. E. Guthrie, September 1972.

c. Nuclear Fuel Supply, WASH-1242, U.S. AEC, May 1973.

The report indicates that the annual production rate from presently estimated $8 resources could be increased to about the level of demand projected for 1979. Subsequent needs might be met from known resources for a few years, but then, new low-cost resources would be required or higher-cost resources could be exploited if available. Doubtless, a large expansion of uranium exploration and production facilities will be needed.

It is believed by TVA and its consultants that the key to the supply outlook is the development of new reserves rapidly enough to keep pace with projected requirements. Both the short-term and long-term uranium supplies are closely related to the establishment of acceptable market prices in the 1980's, and the known reserve levels will be expanded by further exploration effort.

9.2.0.3 Economic Comparison of Baseload Alternatives - One of the major factors considered in the feasibility study of the alternative generating facilities is their comparative economics. Table 9-1 shows comparative investment costs, fuel costs, and operating and maintenance costs for the baseload alternative types of generating facilities studied during the 1980-82 period.

The investment costs are in terms of costs expected in the 1980-82 period. Substantially larger furnace volumes and more pulverizer capacity are required to burn low-sulfur coal, and the plant investment cost for low-sulfur coal reflects these requirements.

The indicated fossil fuel costs reflect the best judgement of today's market for these fuels. There are means of mitigating the cost associated with transporting low-sulfur coal, such as use of a coal slurry pipeline. Since this method of transporting coal is only in the preliminary stages, it has not been reflected in low-sulfur coal costs. Based on the recent bids for low-sulfur coal and discussions with coal suppliers, the reduction in the cost of transportation is not sufficient to result in the coal cost of this alternative being reduced below the breakeven fuel cost of approximately 30 cents per million Btu.

The comparison shows that the baseload nuclear plant offers a 3.1 mil per kWh economic advantage over the low-sulfur coal-fired plant, which is the next lowest cost alternative. This represents an annual production cost advantage for the nuclear plant of about $55 million for a 2,500-megawatt plant.

From the standpoint of economics, it has been concluded that nuclear capacity is the most attractive alternative type of feasible baseloaded capacity.

9.2.0.4 Potential Environmental Impact Comparison of Baseload Alternatives - Table 9-2 summarizes, and quantifies to the extent practicable, the potential environmental impacts associated with the baseload alternative types of generating capacity.

Air Pollution - Degradation of the air quality because of fossil-fired power plant operation results principally from the emission of SO_2, NO_x, and particulates. The values shown for SO_2 emissions in Table 9-2 assume that any new installation could meet the most restrictive SO_2 emission standard promulgated today.

The technology of removing sulfur dioxide from the exhaust gas stream of a power plant has not been demonstrated on a scale large enough to justify making long-range plans for the use of stack gas scrubbers to control sulfur dioxide emissions. There are several competing processes[d] for removing sulfur dioxide from flue gas, none of which has yet operated for a sufficient time or on a sufficient scale to be called demonstrated technology. The outlook for the near future is not encouraging because of the inherent difficulty of extracting small concentrations of sulfur dioxide from very large volumes of gas. Furthermore, many of these processes produce substantial quantities of residual slurries that also pose significant environmental concerns.

NO_x emission levels vary considerably among the various boiler designs. The emission levels shown in Table 9-2 are representative of today's boiler and gas turbine technology.

The particulate emission levels listed are based on the most restrictive standard proposed to date: 0.1 pounds of ash per million Btu input.

The only nonradiological atmospheric emissions associated with nuclear plants other than plumes from cooling towers, spray canals, or cooling ponds are small quantities of SO_2 and particulates from operation of auxiliary boilers and emergency diesels. These emissions are expected to be minimal. Atmospheric effects from cooling towers, spray canals, or cooling lakes may be significant depending on site location and the type of cooling scheme used. The alternative type of generation with the least impact on air quality is nuclear.

Thermal Pollution - Table 9-2 indicates that heat rejected to the total environment—air and water—and that rejected to the condenser cooling water. This breakdown gives recognition to the higher thermal efficiency of coal-fired plants and to the fact that a portion of the heat rejected to the environment from fossil units is rejected directly to the atmosphere from the boiler, and consequently, total heat rejected to the environment and the cooling tower evaporation rate is less.

Radioactive Effluents - Based on TVA's analysis of previously committed light water reactors, both liquid and gaseous radioactive

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d. Paul W. Spaite, "SO_2 Control: Status, Cost, and Outlook," Power Engineering, October 1972, pp. 34-37.

effluents from nuclear plants can be held to within the limits of proposed Appendix I to 10 CFR Part 50.

Coal contains small amounts of uranium, thorium, and their daughter products most of which remain in the fly ash or bottom ash after combustion. Thus, small quantities of these radionuclides are discharged from fossil-fired power plants. Because of the physical form of this natural radioactivity (bound in fly ash or clinkers) it is believed that the radiological impact of this material would be small.

Impacts Associated With Fuel - Table 9-2 indicates the estimated annual fuel consumption rates of each alternative for a 1,200-megawatt installation. The indicated rates result in significant differences in terms of the quantity of fuel required for mining and transportation.

A 1,200-megawatt nuclear installation requires about 200 tons of U_3O_8 per year. Based on the current industry averages[e] of approximately a ton of ore mined to produce 4 pounds of U_3O_8, 100,000 tons of uranium ore would have to be mined and milled.

The transport of fabricated fuel containing slightly enriched uranium to a plant site involves only minimal impact. A 1,200-megawatt unit would require only 5-10 truck shipments per year.

A baseload 1,200-megawatt coal-fired plant would require that 3.5 million tons of coal be mined and transported to the plant site. Transport of this coal would require that approximately 35,000 100-ton railcars be moved in and out of the plant each year.

While the overall impact of each alternative type of generation on fuel mining and transportation differs, the environmental impact of each alternative can be mitigated with proper reclamation practices. In the case of uranium mining, open-pit mining poses the more serious environmental impact; however, because of the relatively small concentrated areas in which uranium ore is found, its impact is limited.

TVA's final environmental statement, "Policies Relating to Sources of Coal Used by the Tennessee Valley Authority for Electric Power Generation," discussed the environmental impact associated with the mining of coal and described the policies and efforts of TVA to minimize these impacts. In particular, TVA's surface mining policies are designed to utilize a finite resource while at the same time making sure that the long-term productivity of the land will generally be equal to or greater than its premining productivity.

Waste Disposal - Offsite disposal would be required for radioactive material. A 1,200-megawatt plant would require 5 to 10 rail

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e. Fuel Trac Quarterly Report, April 1972, page I-1.

shipments per year of spent fuel to reprocessing plants. Approximately 30,000 kilograms of fissile material--depleted uranium and plutonium--would be recovered from the spent fuel with a portion of the remaining fission products requiring permanent disposal by the fuel reprocessor. For other plant-associated low-level radioactive wastes such as demineralizer resins, evaporator bottoms, and debris, approximately 10 to 20 truck shipments per year would be required.

A 1,200-megawatt baseload coal plant would require a landfill area of sufficient size to dispose of approximately 1/2 million tons of ash per year. Over the life of the plant about 5,000 acre-feet of storage would be required for ash disposal. If SO_2 scrubbers are employed, special precaution would be required to assure that the resulting toxic redisual does not escape from the storage area.

Land Use - The land required for a nuclear plant is principally a function of exclusion radius. The exclusion radius does not vary significantly between a 1-unit plant or a 4-unit plant. Consequently, assuming cooling towers are used for auxiliary cooling, the 800-1,000 acres indicated on Table 9-2 would accommodate a 1,200-megawatt or 5,000 megawatt installation. The land requirements would be somewhat different if cooling ponds or spray canals were used. The configuration of land ownership and site characteristics could also increase land requirements above these figures for a particular selected site.

A 1,200-megawatt baseload coal-fired installation requires about 800-1,000 acres. A larger installation would require more land. Such an installation would generally be compatible with existing industrial land use.

Aesthetics - The most significant features of a nuclear installation are perhaps the visual impact from cooling towers and the resulting plumes, while for a coal-fired project, tall stacks, cooling towers and plumes, fuel storage facilities, and massive structures have a significant visual impact.

Noise - There are some noise levels associated with switchyards that are generally common to each alternative, but in general, the size of the plant site reduces noise levels at site boundaries to acceptable levels.

For the coal-fired plant, a major source of offsite noise is the coal-handling equipment. Nuclear plants eliminate this source of noise.

9.2.0.5 Conclusion - The following conclusions form the basis for the recommendation of the preferred type of alternative generation for the 1980-82 period:

1. System needs dictate the need for baseload capacity additions.

2. From the standpoint of fuel availability coal and nuclear fuels are available and involve significantly less risk of short

supply than oil-fired plants. The uncertainty of a reliable source of oil precludes serious consideration of an oil-fired unit at this time. There is no evidence to indicate natural gas will be permitted for baseload power generation, and consequently it is not considered as a viable alternative.

3. At this time, the most feasible method of providing baseload coal-fired capacity while meeting SO_2 emission standards based on today's technology and fuel availability appears to be by the use of low-sulfur coal.

4. A nuclear plant has an annual economic advantage of approximately $55 million over a low-sulfur coal-fired alternative based on a 2,500-megawatt installation.

5. The potential environmental impacts of nuclear plants are considered to be less than those associated with other baseload capacity because (1) nuclear plants have no significant SO_2, NO_x, or particulate emissions; (2) nuclear plants require less land than comparably sized baseload fossil plants; (3) nuclear capacity involves less of an environmental impact from mining and transportation because of smaller quantities of ore required and the concentration of uranium deposits: (4) nuclear units produce a substantially smaller volume of waste material requiring disposal than fossil even though care must be exercised in the handling and disposal of nuclear wastes; and (5) a nuclear plant results in cleaner, quieter, more aesthetically pleasing power plant installation.

The radioactive releases from a nuclear power plant during normal operation can be held within applicable standards with the application of current technology. Consequently, these releases are considered to be an insignificant environmental factor in the comparisons of alternatives.

Thus, from the overall consideration of feasibility, cost, and potential environmental impact, nuclear plants are judged to provide the preferred type of baseload capacity addition now available to meet TVA's power supply requirements for the 1980-82 period.

9.2.1 Selection of Candidate Areas - The TVA Act requires that an ample amount of low-cost electricity be provided throughout the area in which TVA conducts its operations. This responsibility requires the need for ongoing studies covering all aspects of the TVA power program. As an integral part of this program, studies of sites suitable for location of generating facilities is essential. In order to meet the peak load periods projected, TVA will have to increase its generating capacity substantially in the foreseeable future. This large-scale

growth requirement will demand the identification of many suitable sites. In planning ahead to meet future load growth, the selection of the preferred site for a particular facility involves the best balance of the engineering, economic, and environmental factors related to the areas of required additional capacity in TVA's power system. Numerous candidate sites will continue to be considered in subsequent siting studies as appropriate as part of the continuing process to determine the best location for adding electrical generating plants to the TVA power system.

The TVA siting procedure is designed to meet its responsibilities to provide an ample supply of electrical energy throughout the region. Studies are initiated on a timely basis to:

1. Identify the portion of the system in which a particular capacity addition is most desirable. These studies are based primarily on projected load and supply requirements of various regions and include an assessment of the transmission flexibility. The results of these studies indicate the priorities to follow in further investigations.

2. Identify and investigate feasible sites in the areas of study based on the priorities established in step 1. The establishment of priorities takes into account the total power program and considers requirements of previously committed capacity and the constantly changing lead-time requirements that are now evolving.

3. Perform site studies and gather onsite data for possible candidate sites on a schedule consistent with the requirements of the capacity addition being considered.

4. Evaluate candidate sites and select the preferred site based on the investigations performed in step 3 above on a time schedule consistent with the inservice dates of the specific capacity addition under study.

Historically TVA's siting studies have been conducted to meet the requirements of the type of capacity being considered for installation. With the consideration of nuclear capacity these investigations have become more intensive to meet the stringent engineering requirements of nuclear power plants and the associated environmental considerations.

The TVA site screening process identifies the more favorable sites after considering such factors as access, proximity to transmission interconnections, flooding conditions, topography, seismology, and potential environmental impacts. The more favorable sites are studied further taking into account priorities set from regional load and supply factors, long-range transmission planning, and the allocation of available resources. In this manner the expensive and time-consuming process of gathering sufficient detailed site-related data to ascertain site feasibility is kept abreast of current needs.

An essential part of TVA's siting process is designed to minimize the investment in the transmission system by locating generating facilities in those areas of the system where forecasted demands require additional generating capability. This avoids the necessity of constructing long transmission lines from areas of surplus generation to serve the load centers of other areas, thus reducing transmission investment, associated losses, and environmental impacts associated with transmission lines. In some parts of the country the relationship between load and supply has become less important with the advent of EHV transmission; however, because of the size of the TVA area and the large investments involved, the geographic relation of generation to load has been and continues to be an important siting consideration and is a principal factor used to establish area investigative priorities.

In order to study load growth and the general power flows in the system and to determine the effects of the specific location of power generation sources, the TVA power system has been divided into five study areas. These areas as shown in Figure 9-1 coincide roughly with the five TVA Power Marketing districts (Western, Central, Eastern, Alabama, and Mississippi) and divide the system according to the concentration of load centers (Memphis; Nashville; Knoxville; Chattanooga and Huntsville; and Muscle Shoals and Mississippi). While these areas are shown individually, the system is not in fact divided since these areas are strongly interconnected with transmission lines.

The load growth in areas 1, 2, and 5 (Western, Central and Mississippi areas, respectively) are roughly comparable with system trends, but with no scheduled additions in generating capability through 1979, the new demands could exceed the areas' generating resources.

This trend is most accentuated in area 2 where the deficits in generating capabilities exceed 4,500 megawatts by the winter peak of 1981 and approximately 6,000 megawatts by 1985. Areas 1 and 5 which have large seasonal swings are in basically the same situation as area 2 but to a lesser degree. Areas 3 and 4 (Eastern and Alabama areas) have capability resources in excess of projected demands with one exception—analysis of areas for winter 1985 shows a deficit of approximately 600 megawatts. Therefore, from area load and supply analysis, area 2 was a principal candidate area for future generating resources during the 1980-82 period.

Although meeting the projected area 2 load requirement is of first priority, the needs of areas 1 and 5 cannot be overlooked. During the 1980-82 period these areas will demand sizable amounts of energy to meet interchange commitments and seasonal requirements. Although transmission proximity is an important consideration, studies cannot be based solely on one area's requirement but must be conducted from the standpoint of system stability and reliability. Therefore, two basic considerations in site location studies are:

1. Proximity to projected high load growth areas, and

2. System transmission stability and reliability associated with requirements existing and projected.

A load and supply analysis indicated area 2 as having the primary needs for generating resources during the 1980-82 time period. This, in combination with its known seismic characteristics made area 2 the primary area of concentrated study for the preferred location. Figure 9-2 shows the area roughly defined as area 2 and the sites identified in the area.

9.2.2 Selection of Candidate Sites - Since 1970 studies have been conducted in area 2 with a total of 48 sites being identified through FY 1972 (see Figure 9-2). In July 1972 TVA concluded the first phase of investigations in area 2. These studies were based on each site's conformity to the stringent requirements for present-day generating plants. Included in the preliminary screening processes were the following:

1. Map reconnaissance, aerial survey, and field reconnaissance
2. Land use and ownership assessment
3. Proximity to existing transmission lines
4. Site access - rail, highway, barge
5. Proximity to population centers
6. Seismology
7. Availability of cooling and/or makeup water and water use compatibility
8. Topography of the site
9. Flooding conditions
10. Foundation conditions
11. Proximity to significant recreational, wildlife, or cultural areas

Based on these studies it became apparent that some of the 48 sites were not economically suitable for the development of a nuclear plant due to such factors as low plant grade, land use conflicts, and inadequate foundation conditions. Four sites were found to meet the requirements of a 4-unit nuclear plant and were judged to be superior to other candidate sites after considering the above factors. These were the Antioch and Hartsville sites on the Cumberland River and the Council Bend and Rieves Bend sites located on the Duck River.

The general location of these sites is shown on Figure 9-3.

The discussion of the four candidate sites is limited in scope to the principal factors related to the selection of the preferred site. The information reported in this section corresponds to the information and data which was available at the time TVA evaluated the candidate sites and selected the Hartsville site as the preferred site. Therefore, the Hartsville site characteristics presented in this comparison may differ from information described in other sections of the environmental statement which was obtained as a result of the more intensive Hartsville site investigations performed after Hartsville was selected as the preferred site. To date these more intensive studies of the

Hartsville site have not revealed any significant changes in site characteristic or previously undetected factors which would alter the selection of the Hartsville site as the preferred site.

9.2.2.1 Site Descriptions - Antioch site is located on the north shore of the Old Hickory Reservoir at Cumberland River Mile 259 in Sumner and Trousdale Counties, Tennessee, approximately 6.5 miles southwest of Hartsville, Tennessee. The site would consist of approximately 950 acres of moderately rolling terrain, most of which is densely wooded. Ground surface elevations range from 445 feet along the reservoir to over 600 feet above mean sea level at a hilltop near the western boundary of the site. Highway access to the site would require less than 1 mile of new road from U.S. 231. Railroad access would be provided with the addition of 8.6 miles of connector track to the L&N Railroad, north of the site. The Cumberland River is navigable from its mouth to the site, and therefore barge facilities are feasible at this site. The smallest downstream lock is at the Old Hickory Dam (84 feet by 400 feet).

The Hartsville site is located on the north shore of the Old Hickory Reservoir at Cumberland River Mile 285, in Smith and Trousdale Counties, Tennessee, approximately 5 miles southeast of Hartsville, Tennessee. The site would consist of approximately 1,400 acres of rolling terrain with surface elevations ranging from 460 to 560 feet above mean sea level. Highway access would require rebuilding about 0.5 mile of existing secondary road to connect the site with Tennessee State Highway 25 located north of the site. Rail access would require approximately 6.4 miles of new track to connect the site with the L&N Railroad near Hartsville, Tennessee. Barge facilities are feasible at this site.

Council Bend site is located on the left bank of the Duck River at river mile 60 in Hickman County, Tennessee, approximately 4 miles northeast of Centerville, Tennessee. The site would consist of approximately 1,400 acres of farmland, which is now used mostly for pasture; ground surface elevations vary from approximately 460 feet along the river to over 540 feet above mean sea level at the high ground immediately inland from the plant site. Highway access to the site would require approximately 2 miles of new road extending from Tennessee State Highway 50. Rail access would require a bridge to be constructed across the river to connect with the L&N Railroad about 3 miles east of the site. Barge facilities are not feasible at this site due to the nonnavigability of the Duck River.

Rieves Bend site is located on the south shore of the proposed Columbia Reservoir at Duck River Mile 146 in Maury County, Tennessee, about 3 miles southeast of Columbia, Tennessee. The site would consist of approximately 1,500 acres with ground surface elevations varying from 630 feet to 740 feet above mean sea level. Highway access for this site would require about 2.5 miles of new road to connect the site with Tennessee State Highway 50 which connects with I-65. Rail access would require 2.5 miles of new track and the crossing of two embayments of

the Columbia Reservoir to connect the site with the L&N Railroad. Barge facilities are not feasible at this site due to the nonnavigability of the Duck River.

Detailed investigations of these four sites were designed to cover the major site evaluation factors grouped in three basic categories--transmission requirements, engineering feasibility, and environmental impacts. These categories are discussed in the following subsections.

9.2.2.2 Transmission Requirements - Estimates were prepared for the transmission line interconnections necessary to connect the plant to the TVA transmission system network that would exist in the 1980-82 period at each of the four alternate sites. These estimates were made to determine the number of transmission connections and the general route of each. A more detailed survey and analysis would be required to determine the best alternative route for each line. Consequently, these estimates were more indicative of the system electrical requirements and reflect the comparative differences between sites rather than the ultimate choice of transmission line routing for a particular site.

System network studies indicated that at least six 500-kV transmission lines will be required to connect the 4-unit plant into the system for plant stability, reliability, and for proper distribution of the generation to the load centers in the area. In addition to these direct connections, the location of large blocks of generation also influences the transmission requirements in other portions of the system to provide the ability to transport power from one portion of the system to another during seasonal changes in power flow and during periods of system emergencies.

Figure 9-4 shows the base transmission network configuration as projected for the 1980-82 period into which the plant would be connected. Proposed requirements for each site are as follows.

Antioch - About 377 miles of 500-kV lines and 8 miles of 161-kV lines will be required for this site. Six 500-kV transmission lines are proposed as follows.

1&2.	Bull Run - Wilson 500-kV loop single circuit -	36 miles
3.	Wilson 500-kV substation connection -	16 miles
4.	Montgomery 500-kV substation connection -	65 miles
5.	Two lines for Maury 500-kV substation connection -	70 miles
6.	Two lines for Maury 500-kV substation connection -	75 miles
	Total 500-kV connections	262 miles
	Browns Ferry-Union substation connection	115 miles
	Total 500-kV requirements	377 miles

Hartsville - The transmission connections to the Hartsville site would be basically the same as those for Antioch, except that the transmission line mileages are slightly greater. The transmission lines and mileages are as follows.

1&2.	Gallatin Steam Plant-Cordell Hull 161-kV loop single circuit -	8 miles
3.	Bull Run-Wilson 500-kV loop single circuit -	34 miles
4.	Wilson 500-kV line No. 2 -	24 miles
5.	Montgomery 500-kV line -	72 miles
6.	Maury 500-kV line No. 1 -	75 miles
7.	Maury 500-kV line No. 2 -	77 miles
	Total 500-kV connections	282 miles
	Browns Ferry-Union substation connection	115 miles
	Total 500-kV requirements	397 miles

Council Bend - If the plant was located at Council Bend about 266 miles of 500-kV lines and 3 miles of 161-kV lines would be required at this site. Six 500-kV lines are proposed as follows.

1&2.	Maury-Cordova 500-kV loop double circuit -	23 miles
3&4.	Davidson-Johnsonville 500-kV loop double circuit -	18 miles
5.	Jackson substation connection -	80 miles
6.	Shelby 500-kV connection -	145 miles
	Total 500-kV connections	266 miles
	Johnsonville-Mount Pleasant to Council Bend single circuit -	3 miles

Rieves Bend - At the present time, there are plans to construct a 500-kV substation in Maury County a few miles north of Columbia, Tennessee—about 10 miles northwest of the Rieves Bend site. If the Rieves Bend site were selected as the preferred location, the Maury Substation would not be built; however, the facilities planned for Maury would be relocated near the Rieves Bend site. The transmission facilities for the Rieves Bend site are as follows.

1.	Loop the Browns Ferry-Davidson 500-kV line into Rieves Bend in lieu of Maury -	2 miles
2.	Extend the Franklin 500-kV line into Rieves Bend instead of Maury single circuit -	7 miles
3.	The Cordova 500-kV line planned out of Maury would be relocated and terminated at Rieves Bend. This would result in 7 fewer miles of 500-kV transmission line.	
4.	A new 115-mile 500-kV line to the proposed Jackson 500-kV substation would be constructed to serve the Jackson, Tennessee area loads -	115 miles

5.	Construct a new 85-mile 500-kV line to the Wilson 500-kV substation -	85 miles
6.	Construct a 170-mile 500-kV transmission line to the proposed Shelby 500-kV substation in the Memphis area -	170 miles
7.	The 500-161-kV stepdown facilities originally planned for the Maury 500-kV substation would be provided at the Rieves Bend site and would serve as an offsite power source -	0 miles
	Total 500-kV connections	379 miles

9.2.2.3 Engineering Feasibility - The engineering feasibility of a site for a nuclear plant is principally a function of three primary considerations.

1. Seismology
2. Geologic conditions
3. Flooding conditions

The following discussion summarizes the results of analyses performed on each site to determine its feasibility.

Seismology - Each of the four sites lies within the same tectonic province, the Nashville Dome. The design criteria for each site would be governed by a reoccurrence of a major earthquake in the Reelfoot Tectonic Structure west of the Nashville Dome. Analysis of a major earthquake reoccurring in the Reelfoot Tectonic Structure shows that the maximum intensity felt at the sites would be MM VII.

For design purposes it was assumed that the greatest acceleration affecting any of the sites would be the result of a major earthquake occurring on the eastern boundary of the Reelfoot Tectonic Structure. Based on the envelope of attenuation curves prepared during the western area earthquake study,[a] the maximum intensity at any of the sites from a major quake on the Rellfoot Tectonic Structure would range from a high of MM VII to a low of MM III.

The maximum acceleration for intensities of this level was estimated to be 0.14 g. On this basis all of the four sites were judged suitable for meeting seismic design requirements of nuclear plants.

Geologic Conditions - From a geologic standpoint, all of the sites could probably be used; however, due to presence of pinnacled rock at Antioch and cavernous zones at Council Bend, an extensive grouting and excavation program would be necessary. An adequate foundation could

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a. "Relationships of Earthquakes and Geology in West Tennessee and Adjacent Areas," Dr. Richard G. Stearns and Dr. Charles W. Wilson, Jr., Vanderbilt University, June 23, 1972.

be obtained at either Hartsville or Rieves Bend at a relatively low economic cost. Due to the presence of bentonite seams at Hartsville, the Rieves Bend site offers the best geologic structure for a nuclear plant foundation. Consequently, the order of geologic preference would be:

1. Rieves Bend
2. Hartsvile
3. Antioch
4. Council Bend

Flooding Conditions - With the exception of Council Bend, all the site grades are sufficiently high to provide protection against flood. Because of the preliminary nature of the calculations, the adequacy of the Council Bend site was considered marginally acceptable.

From the standpoint of the engineering feasibility factors noted above, the order of site preference would be:

1. Rieves Bend
2. Hartsville
3. Antioch
4. Council Bend

9.3 Environmental and Cost Related Factors for Candidate Site Alternatives

9.3.1 Environmental Factors - Table 9-3 lists a summary of the site and environmental characteristics and potential impacts for the four sites.

Land and Land Use - The location of the 4-unit facility at any site will entail a commitment of land resources for the generating plant and the associated transmission lines.

Based on TVA's experience, an exclusion radius of 4,000 feet was estimated to be adequate for this 4-unit plant. Consequently, the land area within the exclusion radius would be approximately 1,200 to 1,400 acres.

Land Use in the Immediate Vicinity of the Sites - Each of the four sites is located in an area where the predominant land uses are for agricultural purposes and forest development and is in an area of low population density. Within a 10-mile radius only minor exceptions are found due to relatively small community developments. Development of the Antioch site would impose potential impacts due to its close proximity to the Old Hickory waterfowl refuge areas; however, no current land use has been identified that would preclude the use of any of these sites for the location of the plant.

Based on the above considerations the order of preference from the standpoint of land use compatibility in the immediate vicinity of the sites is:

1. Hartsville
2. Council Bend
3. Antioch
4. Rieves Bend

Transmission Land Use - Preliminary analysis of new transmission lines (discussed in previous subsection) that would be required to interconnect the plant to the system shows the right of way requirements at Council Bend would be approximately 30 percent less than at the other sites.

Based on the estimated acreage of land required for transmission rights of way the order of site preference is:

1. Council Bend
2. Rieves Bend
3. Antioch
4. Hartsville

Population - Present and projected population information has been prepared for each site alternative and are shown in Figures 9-5 through 9-12.

Present population data is based on the 1970 census. Projected population data is based on county projections prepared by the Tennessee, Alabama, and Kentucky Social Sciences Advisory Committees.

Population Distribution - Population distribution curves have been prepared which compare the relative population concentrations for various radii. Figure 9-13 presents a comparison of each of the four sites and indicates the relative remoteness of the Council Bend site.

After considering current permanent and transient population distributions and projected populations to the year 2000, the overall ranking of the sites is as follows:

1. Council Bend
2. Hartsville
3. Rieves Bend
4. Antioch

Socioeconomic Impacts - At each of the candidate sites the construction of the plant will result in a large influx of workers into the respective areas. Significant impacts will be felt in the housing market and in the demand for public and private facilities, especially schools, and recreation.

Magnitude of Impact - The construction of the plant will involve approximately a 9-year construction period, and during its peak employment period there will be about 4,600 employees at the project.

Table 9-4 shows total employment, number of movers, and school age children for most of the construction period. The number of movers is based on an estimate of two categories of employees. The first category covers movers who are hired from outside the Nashville labor market area and have to move into the area to work. The second category covers movers within the Nashville labor market and within commuting distance but who choose to move for convenience or other reasons. The total number of movers shown in Table 9-4 varies from 300 in the first year of the project to 2,600 at the peak.

Past surveys indicate that the proportion of movers who bring their families has ranged from about 50 percent to 75 percent. Comparing the location of each of the four sites with the other projects and taking into account the number of movers coming from relatively long distances, it is estimated that 65 percent of the movers will bring their families. There is approximately one school age child per family; therefore, the number of school age children ranges from 200 after the first year to 1,700 at the peak.

Housing Availability - Estimates of adequate or sound vacant housing in the areas considered are not available. However, the 1970 Census of Housing reports vacant housing by availability of plumbing facilities. Although conventional housing is still the most desired type of accommodation, mobile homes are increasingly being used by TVA construction workers. In 1968, 20 percent of the movers surveyed lived in mobile homes as compared with 45 percent in 1972. Based on this trend, mobile homes are likely to be the predominant mode of housing at each site.

Impact on Schools - School districts in and near previous TVA projects have used available Federal assistance to cover additional costs of operation. However, capital outlay costs for additional classrooms, equipment, and buses are beginning to cause major problems for local and state agencies. Previously, capital outlay expenditures were made which took care of the temporary impact enrollment due to construction. These same facilities were used later to accommodate normal growth or to accomplish school consolidation.

Based on an evaluation of the probable impacts on schools and housing at each of the proposed sites, the Rieves Bend site would have the greatest adaptability to cope with the large-scale immigration. Rieves Bend, due to its proximity to Columbia, Tennessee, should require only one-fifth the number of temporary classroom facilities for schools as the other sites. However, mitigation of the housing impacts is a problem basic to each of the sites and can only be resolved by a vigorous and comprehensive housing plan. Therefore, the order of minimal socioeconomic impact is not clearly defined and would be of little relative difference except in the case of schools which would undoubtedly favor Rieves Bend.

Historical Significance - Based on a review of the National Register of Historic Places, state preservation plans, and detailed onsite

consultant reports[a] the Hartsville site was judged to have more potentially significant historical developments than the other candidate sites. Developement of Hartsville would require coordination with appropriate Federal, state, and local officials to ensure the proper consideration of any structures that might be affected by plant construction which are determined to be significant under the National Historic Preservation Act of 1966.

The procedures outlined by the National Park Service, Department of the Interior,[b] provide that historical and environmental considerations may be combined in a single document, the environmental statement, which will be distributed widely for comment by appropriate Federal, state, and local agencies, and interested persons. After consideration of all comments received, a final decision can be made regarding the historical, architectural, archaeological, and cultural significance of properties within the area affected by the project.

Archaeological Significance - Each of the four sites were investigated by TVA's archaeological consultants. The Antioch and Hartsville sites were surveyed by Dr. Major C. R. McCollough. The Council Bend and Rieves Bend sites were surveyed by David R. Evans and David J. Ives, who are consulting archaeologists. These investigations consisted principally of the identification of archaeological sites and historic features which could be affected by steam plant construction and operation at each site. These investigations revealed that the Hartsville site is a relatively rich archaeological location, having the most potential significance of the four sites from an archaeological standpoint.

Ecology - The possible biological impacts at the candidate sites were assessed by TVA in cooperation with area universities and consisted of vegetation, wildlife and fisheries surveys. Based on the results of these investigations, the Hartsville site seemed to present the least potential for ecological impacts. Consultants used in these studies are listed below.

1. Vegetational Survey, Antioch Site, Dr. S. K. Ballal, T.T.U. and Allen Skorepa, University of Tennessee

2. Vegetational Survey, Hartsville Site, (same as above)

3. A survey of the Vascular plants of the Rieves Bend area of the Duck River, Maury County, Tennessee, Dr. G. E. Hunter, T.T.U. and Donald Ott, University of Tennessee

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a. Dr. Major C. R. McCollough, Research Assistant Professor, Department of Anthropology, University of Tennessee, Archaeological Surveys of Antioch and Johntown Steam Plant sites on Old Hickory Reservoir near Gallatin, Tennessee, September 15, 1972.

b. 39 Fed. Reg. 6402-77 (1974)

4. A Study of the Vascular Plants of the Council Bend Area of the Duck River, Hickman County, Tennessee, Dr. G. E. Hunter, T.T.U.

5. Wild Land Environmental Assessment, Roger W. Bollinger, TVA; Dr. D. H. Snyder, Austin Peay State University

6. Reptile and Amphibian Habitat, C. Holden Brink, TVA; Dr. Glenn Gentry (retired) Nashville, Tennessee

7. Fish Population Inventory of Two Areas of the Cumberland River - Frank J. Bulow - R. Don Estes, Department of Biology, T.T.U.

Hydrology - Hydrological assessment of the Cumberland and Duck Rivers had not been clearly defined at the time of site assessment due to the potential effects of future reservoir impoundments and their operation. The hydrologic features of the Cumberland River sites would be affected by the operation of the newly constructed Cordell Hull Dam. If the proposed Normandy and Columbia Dams are constructed as planned, the hydrologic characteristics of the Duck River sites would be significantly altered.

Water Use Compatibility - The requirements of the plant would have potential impacts on water use in three principal ways.

1. Alteration of the physical and chemical characteristics of the water in the immediate vicinity of the plant.

2. Evaporation of substantial quantities of water for operation of cooling towers.

3. Discharge of small amounts of radioactive liquid effluents.

An assessment of the effect of thermal and chemical plant discharges on the waters in the immediate vicinity of the sites would depend upon the effect of the reservoir impoundment. Due to the differences in the average annual and minimum flows between the Cumberland and Duck River sites, it would be more difficult for the blowdown from cooling towers to avoid violation of current thermal standards on the Duck River sites. Similarly, a system that cleans up and recycles cooling tower blowdown would likely be required at these sites to stay within water quality standards.

An evaporation loss of 150 ft^3/s from the closed-cycle natural draft cooling towers for this plant would have adverse effects on project benefits for the Normandy and Columbia projects, particularly those for water supply and recreation. The Duck River area, particularly in the vicinity of Columbia, Tennessee, has experienced severe water supply shortages during low-flow periods in the past. The evaporation rate of 150 ft^3/s from this plant represents a major water use conflict.

The withdrawal of this amount of water from the Columbia Reservoir could also result in a 4- to 7-1/2-foot reduction in the recreational pool elevation during dry periods. This much drawdown could detract from the full recreational development of the Columbia Reservoir and consequently is a major disadvantage of selection of the Rieves Bend site for the location of this plant.

The effect of evaporation losses on the Cumberland sites does not pose the same degree of impact and could be avoided entirely by modification in power generation on the run-of-the-river hydro projects; therefore, from the standpoint of water use compatibility, the Cumberland River sites are more favorable.

The third potential impact, the discharge of radioactive liquid effluents, will be discussed as part of the total radiological releases.

Climatology and Meteorology - Onsite meteorological data were not available at any of the candidate sites at the time of site assessment. However, based on an evaluation of the regional climatology and known meteorology at TVA's Browns Ferry, Paradise, and Gallatin plants as well as a review of the National Weather Service data, a relative judgement of the meteorological and site dispersion factors for each site was made. On the basis of these judgements, Council Bend and Rieves Bend sites would have somewhat more favorable site dispersion characteristics than Hartsville and Antioch.

Radiological Impact for Normal Plant Operation - Gaseous Effluents - Based on the preliminary estimates of the meteorological conditions postulated at each site, there is reasonable assurance that the proposed design objectives of Appendix I to 10 C.F.R. Part 50 for routine noble gas and particulate releases would be met at any of the sites.

Based on the combination of postulated meteorological conditions and the population distribution in the vicinity of each site, the estimated population dose within a 50-mile radius of the Council Bend site would have the lowest value by a factor of 2 when compared to the Rieves Bend and Hartsville sites and about a factor of 3 at Antioch.

Radiological Impact for Normal Plant Operation - Liquid Effluents - The liquid radwaste treatment system for the proposed plant will meet the design objectives of proposed Appendix I. Comparison of the Cumberland River sites, Antioch and Hartsville, indicates little difference between them from the viewpoint of doses due to radionuclides in liquid effluents. Liquid effluents from Hartsville would affect two public water supplies that would not be affected by releases at Antioch. However, radionuclides released at Antioch would contribute a larger dose at Nashville, Tennessee, due to the shorter decay time.

On the Duck River the Council Bend site is favored over the Rieves Bend site due to larger dilution, greater distance to the first water supply, and a smaller number of persons served by the public water supplies.

When comparing the Council Bend site with the Cumberland River sites, Council Bend was judged to be a better choice even though the Cumberland River has an average dilution flow about a factor of 65 higher than the Council Bend site. This is due to the smaller number of people served by downstream water supplies from the Council Bend site.

While the Council Bend site could be considered more favorable in relation to the radiological impact due to normal plant operations, it should be noted that liquid radionuclide releases from all plant sites will be as low as practicable and well within Federal guidelines; and, therefore, these releases will result in an insignificant environmental impact.

Transportation - Each of the four candidate sites would require some improvements in both rail and highway access facilities to accommodate the activities associated with normal plant operations. These operations will involve the transport of new fuel to the site, shipment of spent fuel to reprocessing plants, and the shipment of low-level radioactive wastes for offsite burial.

One significant transportation factor in nuclear plants is availability of barge transportation. Barge access to the Council Bend and Rieves Bend sites is not available. Development of these sites for the plant would require substantial improvements in existing highways to obtain a roadway base capable of supporting the overland transport of reactor vessels. Preliminary assessments of the alternative routes indicate that approximately 40 miles of road improvements would be required for access to Council Bend and about 80 miles for Rieves Bend.

Therefore, an overall assessment of the transportation facilities would favor the Cumberland River sites, Antioch and Hartsville, due primarily to the availability of barge access.

9.3.2 Cost Factors - Cost estimates were prepared in three categories of site-related development costs: (1) land acquisition, (2) site preparation, and (3) transmission costs. The total cost of locating the power plant at each of the candidate sites in increasing order is tabulated below in terms of 1972 dollars:

1. Hartsville	\$108.9 million
2. Rieves Bend	
a. With Columbia Dam	\$114.9 million
b. Without Columbia Dam	\$120.1 million
3. Antioch	\$134.7 million
4. Council Bend	\$137.2 million

As indicated, the Hartsville and Rieves Bend sites have essentially the same cost of development with the magnitude of the difference (\$6.0 million) being within the accuracy of the estimate. In order to fully examine all foreseeable factors influencing the relative economic cost of developing each site, the Rieves Bend site was evaluated based on two alternative courses of action. The alternatives posed are a result

of the proposed Duck River Development Project. This project incorporates two impoundments of the Duck River, one of which is located near Columbia, Tennessee, and near the Rieves Bend site. With the construction of the proposed Columbia Dam, considerable economic savings could be realized in the areas of land acquisition and secondary cooling water supplies at Rieves Bend. The Rieves Bend cost estimate includes $8.9 million penalty for recycling system for cooling tower blowdown.

Due principally to the additional expense of an adequate foundation at the Council Bend and Antioch sites, the developmental cost of these sites would be higher than the Hartsville and Rieves Bend sites. While the cost of transmission facilities at the Council Bend site results in a savings ranging from about $13 to $20 million, it requires more foundation treatment and a makeup reservoir for low-flow periods and would likely require a recycling system on the cooling towers. These and other factors more than offset the transmission advantage of Council Bend.

SUMMARY

From the consideration of engineering feasibility, environmental impact, and economics, and after assessing the merits of each site, the Hartsville site was judged to offer more favorable overall characteristics with the least environmental impacts. Listed below are the principal factors considered in arriving at this conclusion.

Economics

Hartsville offers cost advantages over the other candidate sites which range from $6 million at Rieves Bend (with the Columbia Dam) to $28 million at Council Bend.

Engineering Feasibility

From the standpoint of engineering feasibility, Hartsville and Rieves Bend are preferred due principally to extensive foundation treatment required at the Antioch and Council Bend sites. The underlying geological structure generally favors the Rieves Bend site due to the presence of bentonite seams at Hartsville. However, removal of the bentonite material is reflected in the developmental cost of this site and is not considered to be a significant disadvantage to Hartsville.

Ecology

The Hartsville site exhibited the lowest potential for ecological impacts of any of the sites considered.

Land and Water Use Compatibility

Unlike other candidate sites, Hartsville has no present or projected land or water use conflicts.

Historical Significance

Based on reviews of the National Register of Historic Places, state coordination, and onsite studies, the Hartsville site exhibits more potentially significant historic developments than the other candidate sites.

Archaeological Significance

Hartsville contains several more potentially significant archaeological sites than the other sites considered. These archeological sites will be explored and excavated as necessary to determine their significant archaeological value. This activity will add somewhat to the cost of developing this site, but this cost has been factored into the development cost of the site. Thus, the archaeological features are not considered to be a significant negative siting factor since public ownership provides the opportunity for the survey and salvage of potentially significant artifacts that might not otherwise be realized.

Population

The population distribution within a 10-mile radius of Hartsville is second only to Council Bend.

Transmission

A significant disadvantage of Hartsville on a comparative basis would be transmission line requirements. Based on the results of preliminary transmission system analysis, the need for additional transmission facilities would be less at the Council Bend site. The cost of providing the additional amount of transmission facilities at Hartsville is reflected in the comparative cost estimates of each site. Even with the inclusion of additional transmission facilities, Hartsville offers a $28 million savings over Council Bend. It is recognized that the use of the land required for the rights of way associated with the additional 135 miles of transmission lines at Hartsville could present some minor restrictions in land use. However, after considering the offsetting disadvantages of Council Bend in the areas of ecological value and potential land and water use conflicts, the net impact posed by longer transmission lines at Hartsville is judged to be significantly smaller.

Based on the predominant factors discussed, the Hartsville site offers the balance of the significant engineering, economic, and environmental factors and is the preferred location for the nuclear units.

Table 9-1

ECONOMIC COMPARISON OF BASELOAD ALTERNATIVE CAPACITY ADDITIONS

8% Interest

		Coal Fired	
	Nuclear	Low Sulfur	Medium Sulfur[b]
Installed Capacity - new MW	2,473.0	2,533.0	2,488.5
NPHR - Btu/kWh	9,927.0	9,070.0	9,036.0
Fuel Cost - ¢/10^6 Btu	20.0	60.0	45.0
Investment - $/kW (net)[a]	335.2	300.0	341.6
Annual Use - hours	7,000.0	7,000.0	7,000.0
Generating Cost - mills/kWh			
Investment	4.1	3.7	4.2
Fuel	2.0	5.4	4.1
O & M	0.7	0.8	2.0
Totals	6.8	9.9	10.3

a. All capital cost estimates include cooling towers.

b. Includes estimates of SO_2 removal equipment capital and operating costs.

Table 9-2

COMPARISON OF ENVIRONMENTAL IMPACTS OF BASELOAD ALTERNATIVE GENERATION FOR 1,200-MEGAWATT INSTALLATION

	Nuclear	Coal-Fired
1. Air Pollution - tons/yr.		
a. SO_2 emissions[a]	Negligible	42,800
b. NO_x emissions	Negligible	33,600
c. Particulate emissions[a]	Negligible	3,800
2. Heat Rejected - 10^9 Btu/h		
a. Total rejected	6.5-7.8	6.8
b. Total rejected to cooling water	6.5-7.8	5.7
3. Radioactive Effluents	Within Proposed Appendix I Limits	trace
4. Annual Fuel Consumption	200 tons U_3O_8	3,500,000 tons
5. Mining[b]	Underground - 55% Surface - 45%	Underground - 50% Surface - 50%
6. Annual Fuel Shipments		
a. New fuel	5-10 trucks	35,000 railcars
b. Spent fuel	5-10 rail shipments	-
7. Waste Disposal		
a. Ash disposal - thousand tons/yr	-	520
b. Radioactive wastes - truck shipments/yr	10-20	-
8. Land Requirements - acres	800-1,000[c]	800-1,000
9. Noise	Quiet Installation	Fuel-Handling Facilities Principal Source
10. Aesthetics	Predominant Feature is Cooling Towers Large, but Relatively Low-Profile Plant Structure	Tall Stacks, Cooling Tower Structures, and Fuel Storage Facilities Dominate Installation

(See footnotes on following page)

Table 9-2 (Continued)

COMPARISON OF ENVIRONMENTAL IMPACTS OF BASELOAD ALTERNATIVE GENERATION FOR 1,200-MEGAWATT INSTALLATION

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a. Assuming all applicable standards can be met on coal-fired.

b. Based on the current trends of mining uranium and coal in the United States.

c. Also adequate for 4,000-5,000 megawatt installation.

Table 9-3

X17-X20 ALTERNATIVE SITES - SUMMARY OF CHARACTERISTICS

Major Factors Considered	Alternative Sites: Cumberland River: Antioch	Hartsville	Duck River: Council Bend	Rieves Bend
Site Characteristics				
River Mile	259	385	60	146
Acres Required	950	1,400	1,400[a]	1,530[a,b]
TVA-Owned	0	0	0	0
Access				
Highway - miles				
New	1.0	1.0	2.0	5.0
Recond.	0	0.5	40	80
Rail - miles				
New	8.6	6.4	3.0[c]	2.5[d]
Barge Feasibility	yes	yes	no	no
Transmission				
Miles -				
500 kV	377	397	266	379
161 kV	8	8	3	-
ROW - acres[e]	9,240	9,720	6,490	9,190
Engineering Feasibility				
Seismic	(Basically the same for all sites)			
Faulting				
Proximity - miles	27W	36W	25NW	7W
Condition	inactive	inactive	inactive	inactive
Detailed study req'd.	no	no	no	no
Foundation Conditions				
Problems:	Excavation of pinnacled rock, possible water leaks, treatment of cavities	Bentonite beds will require careful selection of plant grade	30' cavernous zone with cavities as large as 10'	None serious
Grouting	extensive	normal	extensive	normal

Table 9-3
(Continued)

X17-X20 ALTERNATIVE SITES - SUMMARY OF CHARACTERISTICS

Major Factors Considered	Alternative Sites: Cumberland River — Antioch	Hartsville	Duck River — Council Bend	Rieves Bend
Flooding				
Plant grade	510	538	510	700
Max. possible flood and max. wave runup	492.8	520.9	513.1	648.8
Failure in OBE (coincident with 1/2 max. possible flood)	510	530	511	637
Environmental Impacts				
Land Use Conflicts				
Present	waterfowl refuge	none	none	none
Projected	same	none	home development	Columbia res. development
Population				
10-mile radius				
1970	21,195	12,320	7,365	31,185
2000	30,605	16,445	12,825	55,530
50-mile radius				
1970	897,265	893,360	550,955	775,875
2000	1,450,255	1,403,975	801,940	1,218,075
Nearest town				
Name	Hartsville	Hartsville	Centerville	Columbia
Distance	8 mi - ENE	5 mi - NW	5 mi - SE	5 mi - NW
1970 Population	2,243	2,243	2,592	21,471
Nearest major urban concentration	Nashville	Nashville	Nashville	Nashville
Distance	33 mi - WSW	43 mi - WSW	46 mi - ENE	40 mi - NNE
1970 population	448,444	448,444	448,444	448,444

Table 9-3
(Continued)

X17-X20 ALTERNATIVE SITES - SUMMARY OF CHARACTERISTICS

Major Factors Considered	Alternative Sites: Cumberland River — Antioch	Cumberland River — Hartsville	Duck River — Council Bend	Duck River — Rieves Bend
Construction Employment				
7-1/2-year avg.	2,400	2,400	2,400	2,400
Peak	4,600	4,600	4,600	4,600
Total Population Increase				
7-1/2-year avg.	2,750	2,750	2,750	2,750
Peak	6,000	6,000	6,000	6,000
Housing Availability				
No. units - 1970	800	800	700	700
Impact on Schools				
Portable classrooms needed at peak[f]	50-60	60	50	10
Historical Sites				
No. of sites[g]	2	1	none	16
Distance to nearest	4 mi	2 mi	-	5 mi
Archaeological Sites				
No. of sites	2	9	-	5
No. of surface indicators	2	9	2	-
Ecology				
Vegetation	No rare or unusual species. Site consists of mostly exposed lime-stone, thickets, and wood lands. No significant ecological losses.	No rare and endangered species. No significant ecological losses.	No rare and endangered species. No unique plant habitat or community. About half the area is wooded--remainder is in agriculture.	No rare and endangered species were observed. No unique floral asso-ciation. No significant ecological losses.
Wild land	Low wild land value.	Low wild land value.	High wild land value.	No significant impact.

Table 9-3
(Continued)

X17-X20 ALTERNATIVE SITES - SUMMARY OF CHARACTERISTICS

Major Factors Considered	Alternative Sites: Cumberland River: Antioch	Cumberland River: Hartsville	Duck River: Council Bend	Duck River: Rieves Bend
Ecology (cont'd)				
Mammals and birds	Low habitat diversity. No significant impact.	No significant impact.	High habitat diversity. No significant impact.	High Habitat diversity. No significant impact.
Reptiles and amphibians	No rare or endangered species. Low ecological value.	No rare or endangered species. Minimal ecological losses.	No rare or endangered species. High ecological value.	No rare or endangered species. High ecological value.
Upland game	No rare or endangered species. Ranks third in hunting value.	Ranks lowest in hunting value. No significant impact.	No rare or endangered species. Highest site in hunting value.	Second highest site in hunting value.
Waterfowl	Least significant impact.	No significant impact.	Highest impact would occur.	No significant impact.
Fisheries	No rare or endangered species. No significant impact.	No rare or endangered species. No significant impact.	One rare fish species may exist. High habitat diversity.	No rare or endangered species. High habitat diversity.
Hydrology				
Streamflow - ft^3/s				
Mean daily	17,500	17,000	3,100	1,710
Min. daily	570	560	325	135
Proximity to Support Facilities				
Reprocessing Plants (road miles ±10)				
Barnwell, SC	430	435	435	395
Morris, IL	410	415	470	450
West Valley, NY	645	650	705	685

Table 9-3
(Continued)

X17-X20 ALTERNATIVE SITES - SUMMARY OF CHARACTERISTICS

Major Factors Considered	Alternative Sites: Cumberland River: Antioch	Hartsville	Duck River: Council Bend	Rieves Bend	
Offsite Disposal Facilities (road miles ±10)					
Barnwell, SC	430	435	435		395
Morehead, KY	275	280	340		320
Economics - $ x 10^3 (1972 Dollars)				Without Col Dam	With Col Dam
Land and associated cost	1,085	1,106	1,712	3,319	215
Site preparation	54,933	25,081	73,535[g]	42,047[h]	40,027[h]
Transmission	78,675	81,715	51,960	74,692	74,692
Total	134,693	107,902	137,207	120,058	114,929
Mineral rights	-	1,000	-	-	-
Total site cost	134,693	108,902	137,207	120,058	114,929
Difference	25,791	base	28,305	11,156	6,027

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a. Does not include requirements for makeup water reservoir
b. Assumes Columbia Dam not constructed.
c. Also requires rail bridge across river.
d. Also requires crossing two Columbia Reservoir embayments.
e. Based on 200-foot right of way width for 500 kV, 100-foot right of way for 161 kV
f. Cost per portable classroom - $15,000.
g. Sites identified in the National Register of Historic Places and those identified in field investigations.
h. Includes estimated operating cost for recycling system.

Table 9-4

TOTAL CONSTRUCTION EMPLOYMENT, TOTAL MOVERS, AND ASSOCIATED POPULATION AND SCHOOL AGE POPULATION

Time Period	Employment	Movers	Population Increase School Age	Population Increase Total
1	1,200	300	200	700
2	2,700	1,100	700	2,500
3	4,000	2,100	1,400	4,900
4	4,600	2,600	1,700	6,000
5	3,700	2,000	1,300	4,600
6	1,700	700	450	1,600

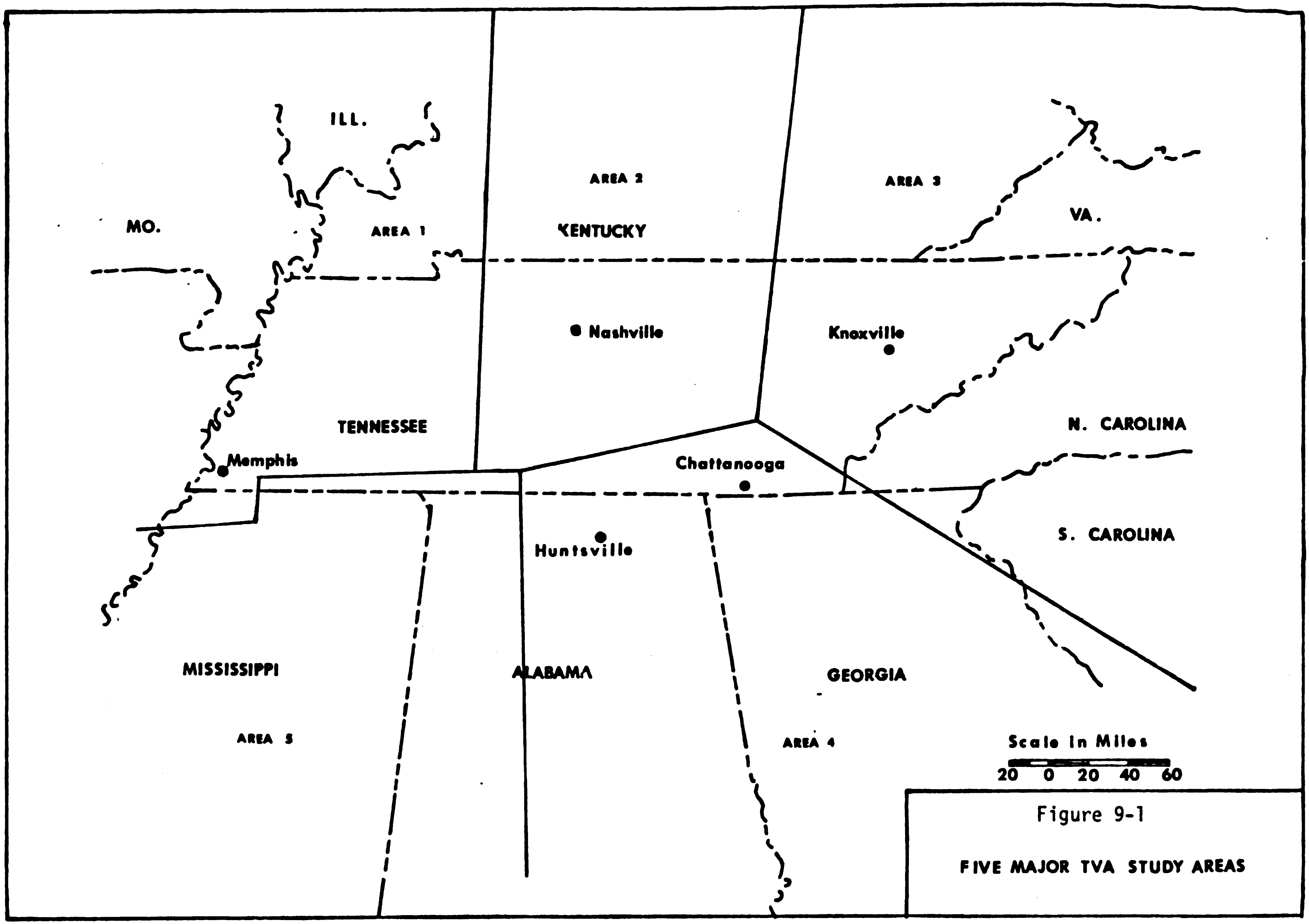

Figure 9-1

FIVE MAJOR TVA STUDY AREAS

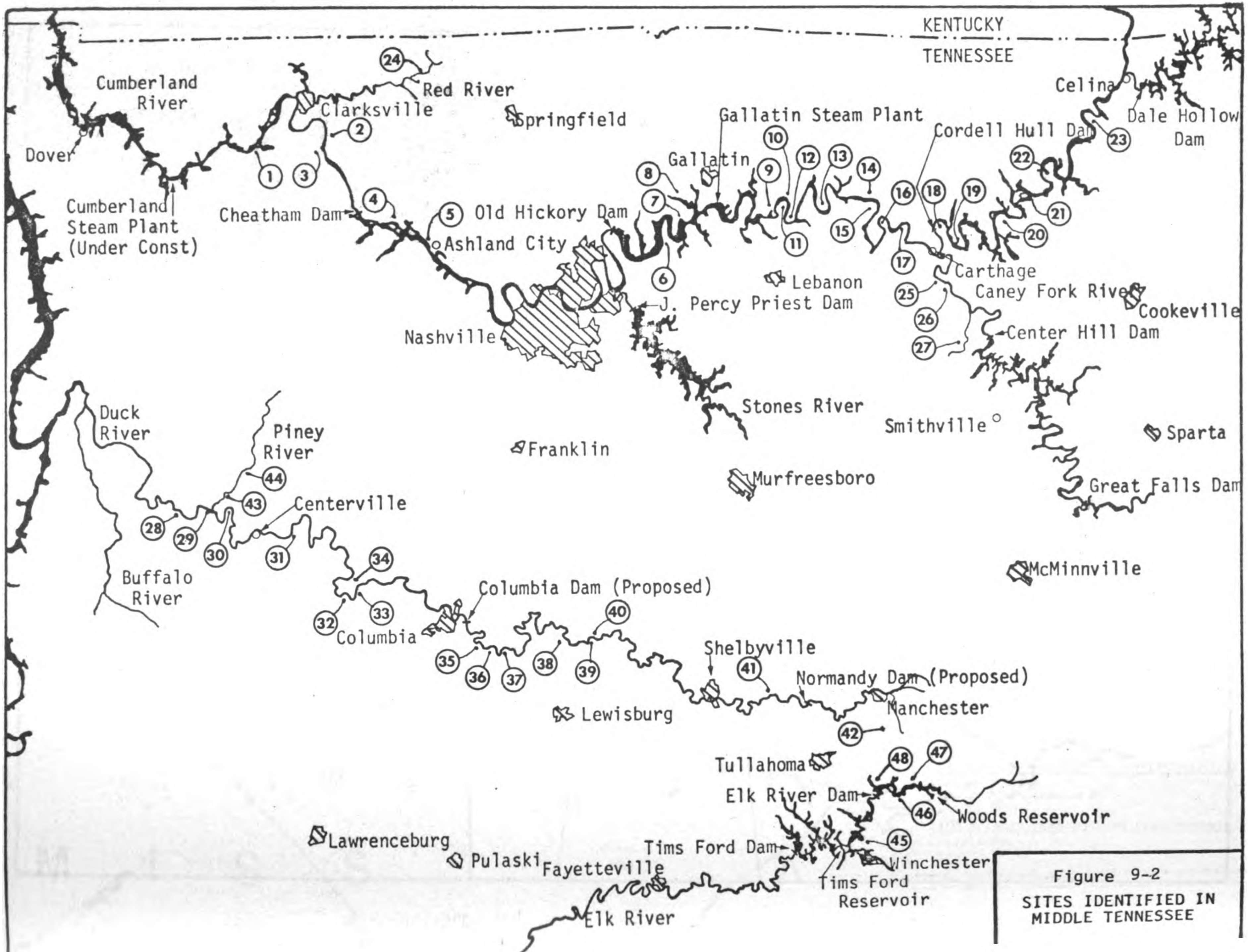

Figure 9-2
SITES IDENTIFIED IN MIDDLE TENNESSEE

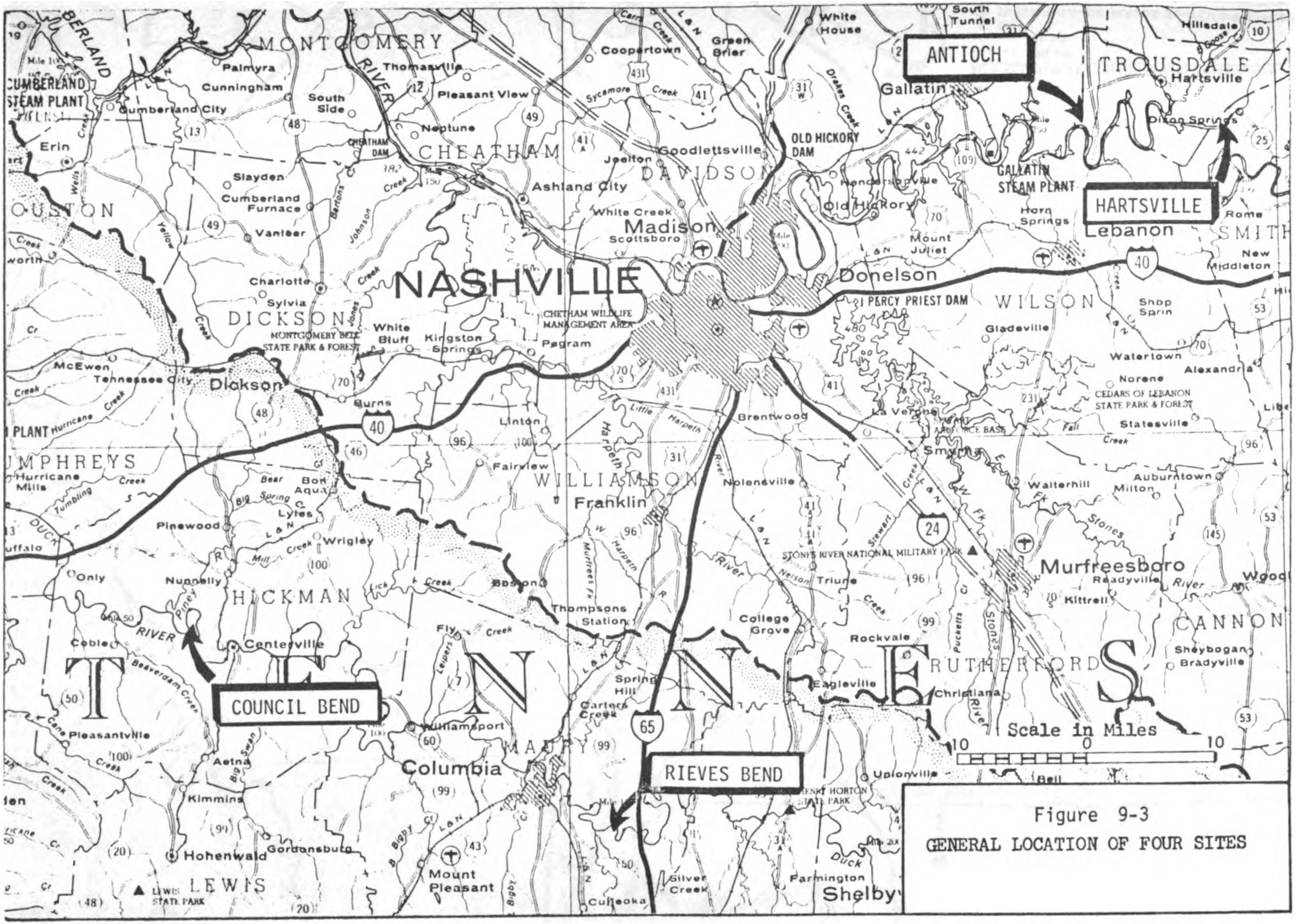

Figure 9-3

GENERAL LOCATION OF FOUR SITES

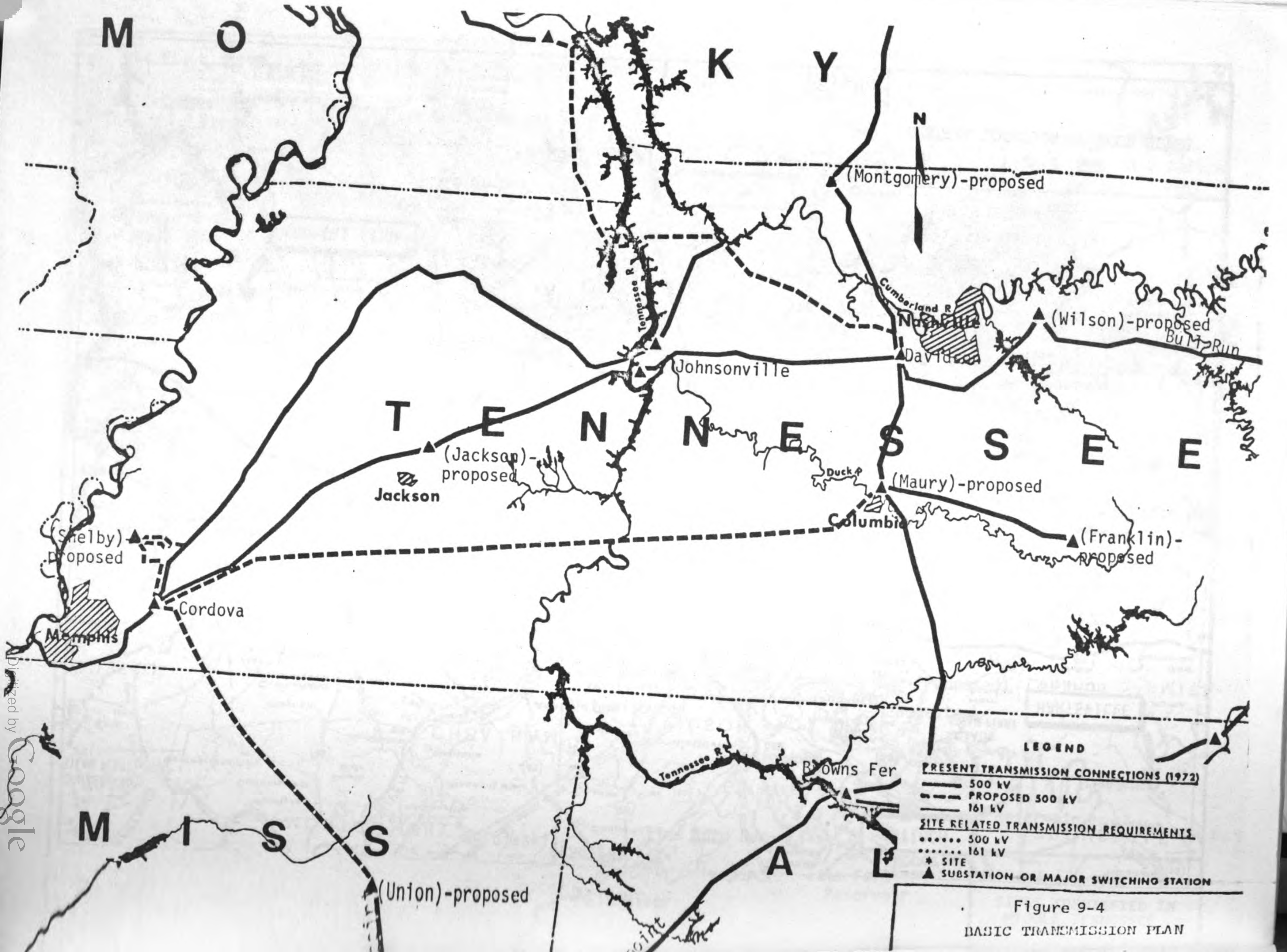

Figure 9-4

BASIC TRANSMISSION PLAN

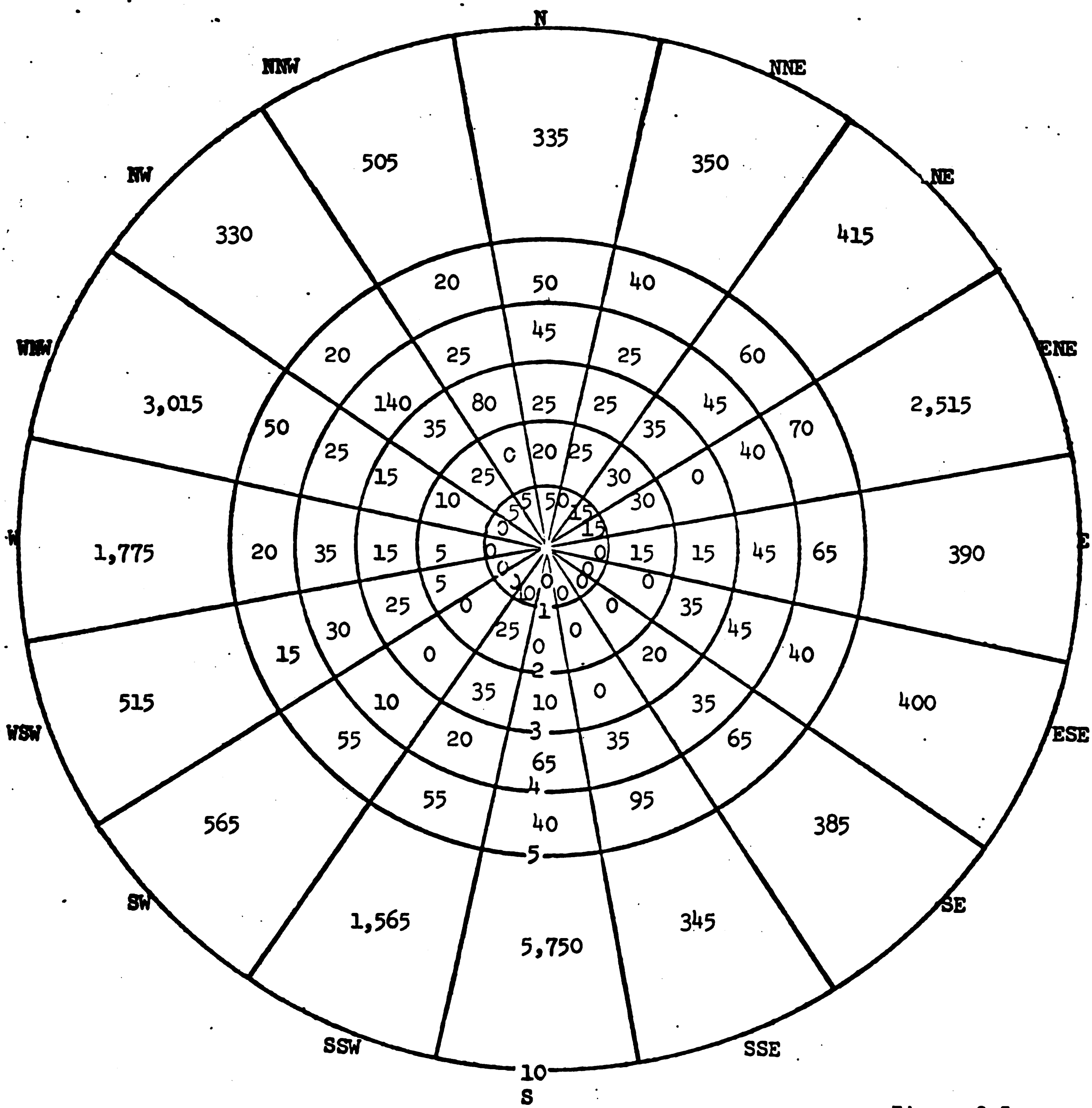

Figure 9-5

POPULATION DISTRIBUTION
ANTIOCH SITE
Year 1970

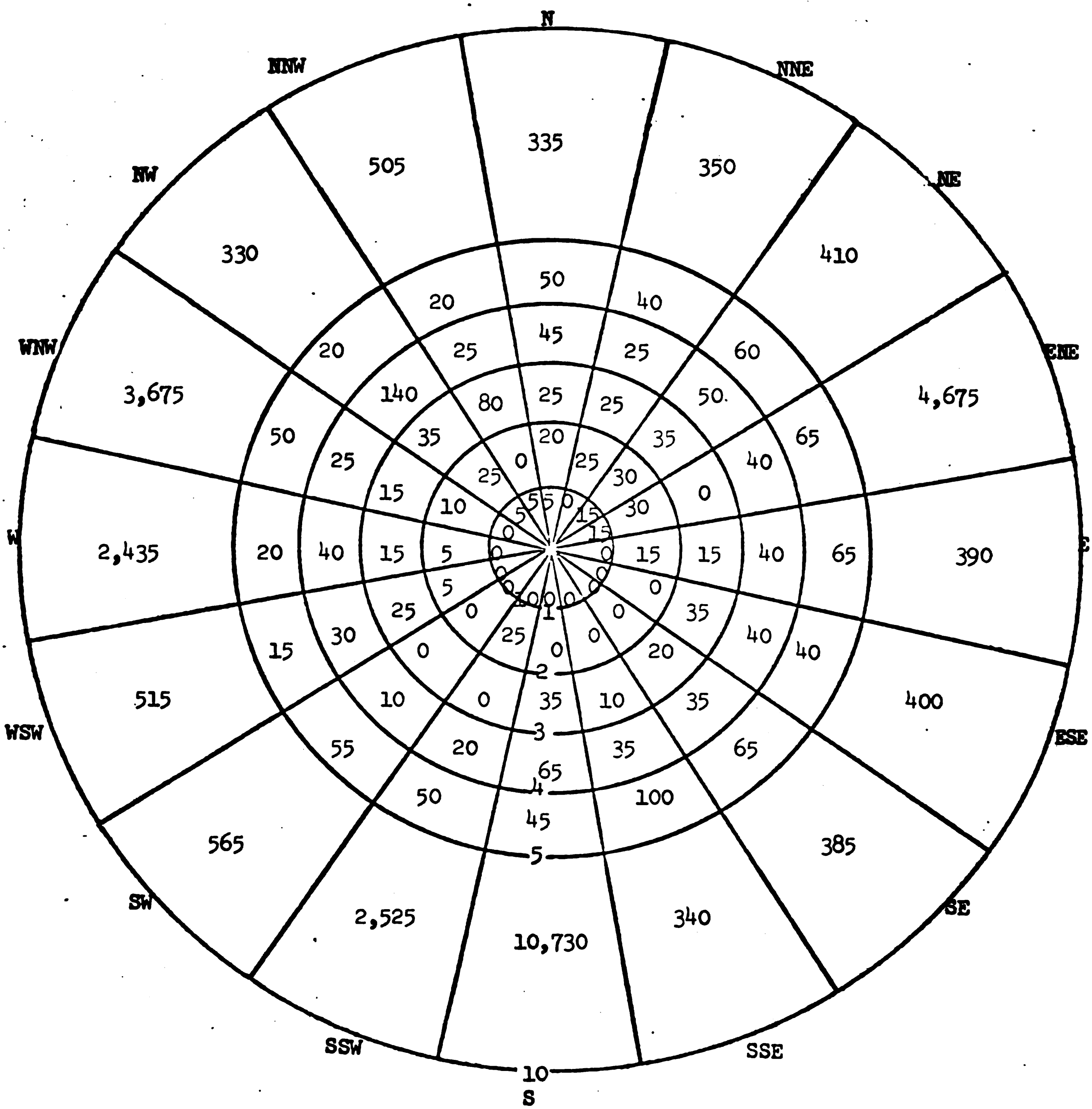

Figure 9-6

POPULATION DISTRIBUTION
ANTIOCH SITE
Year 2000

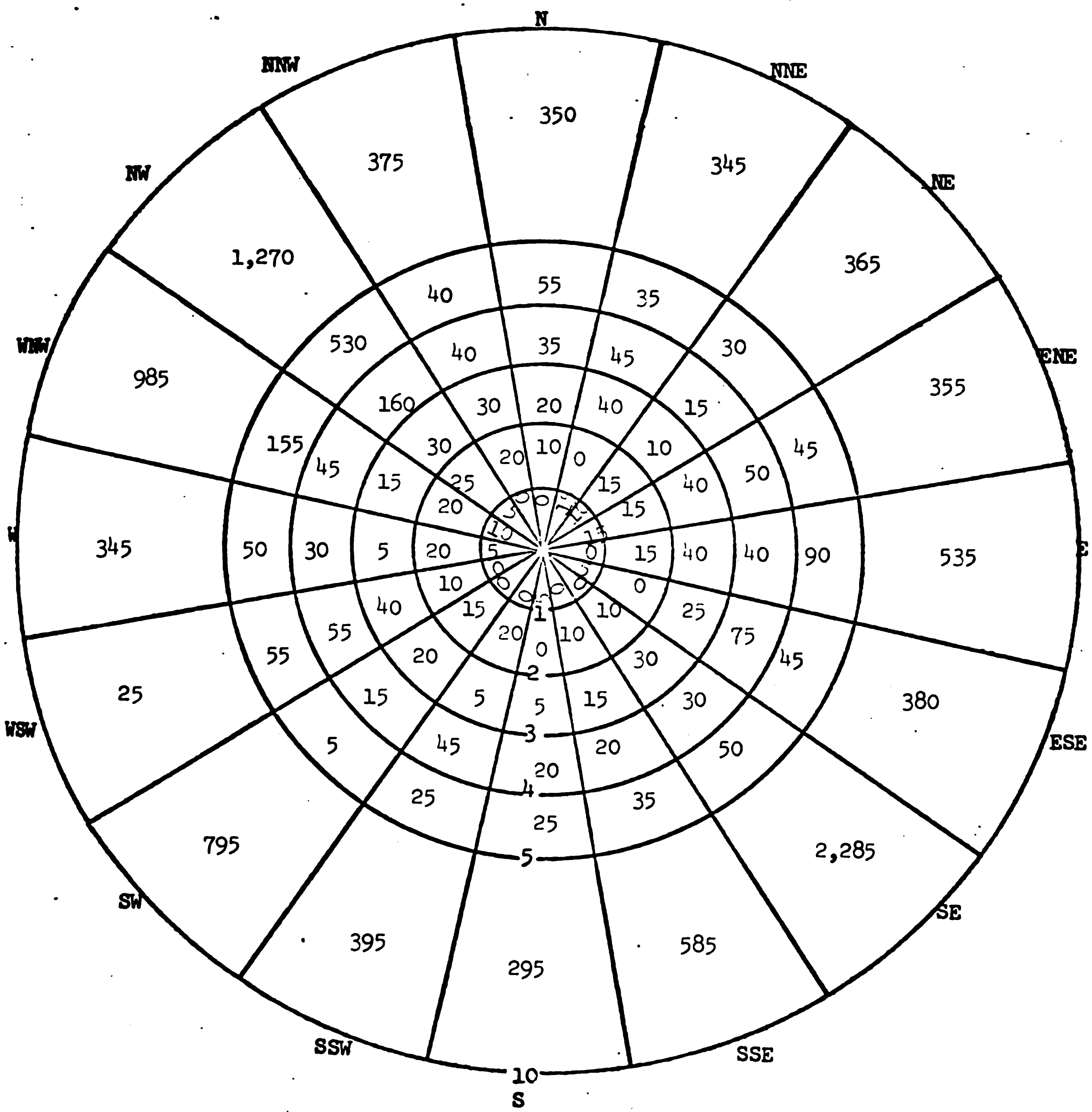

Figure 9-7

POPULATION DISTRIBUTION
HARTSVILLE SITE
Year 1970

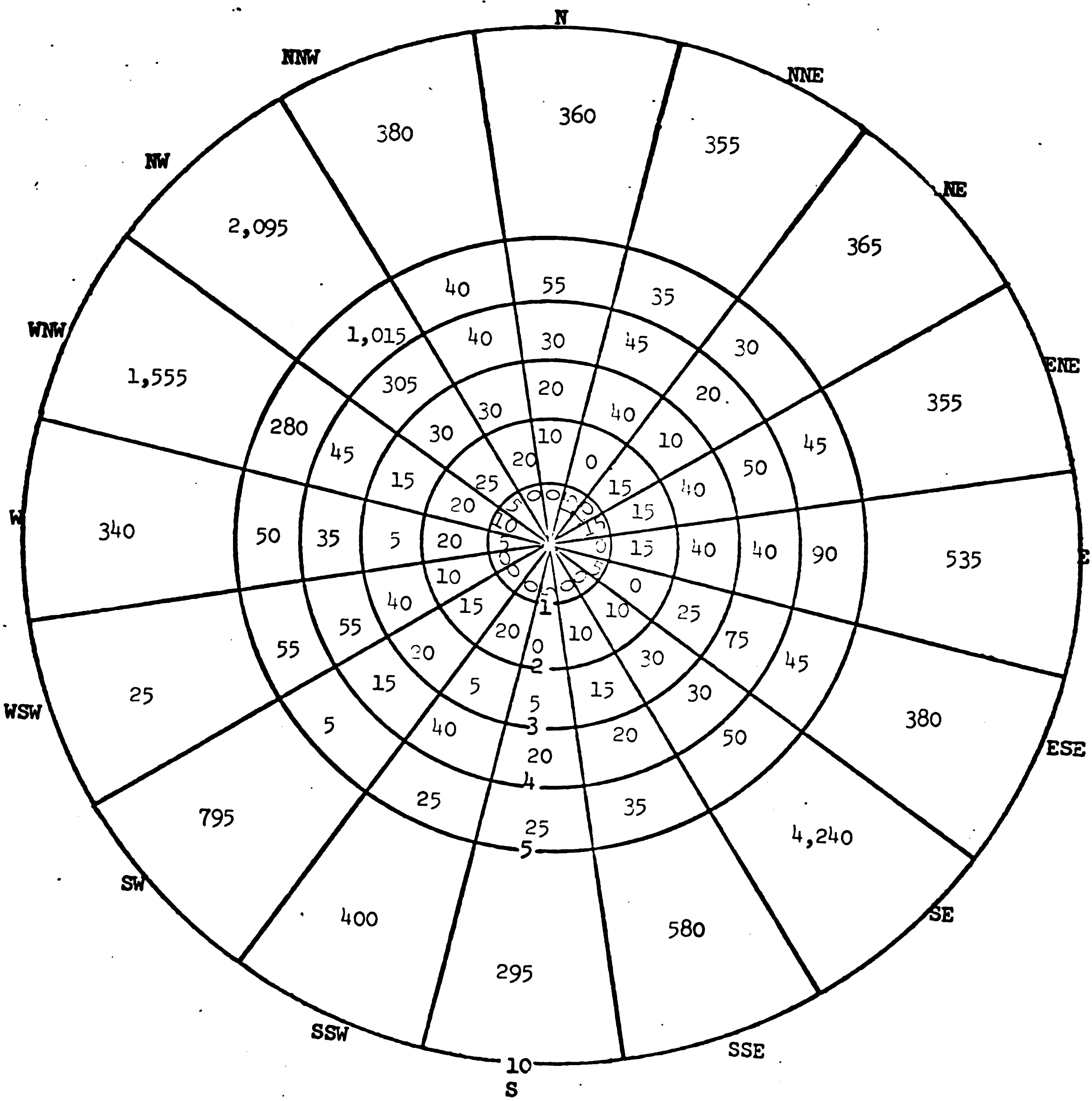

Figure 9-8

POPULATION DISTRIBUTION
HARTSVILLE SITE
Year 2000

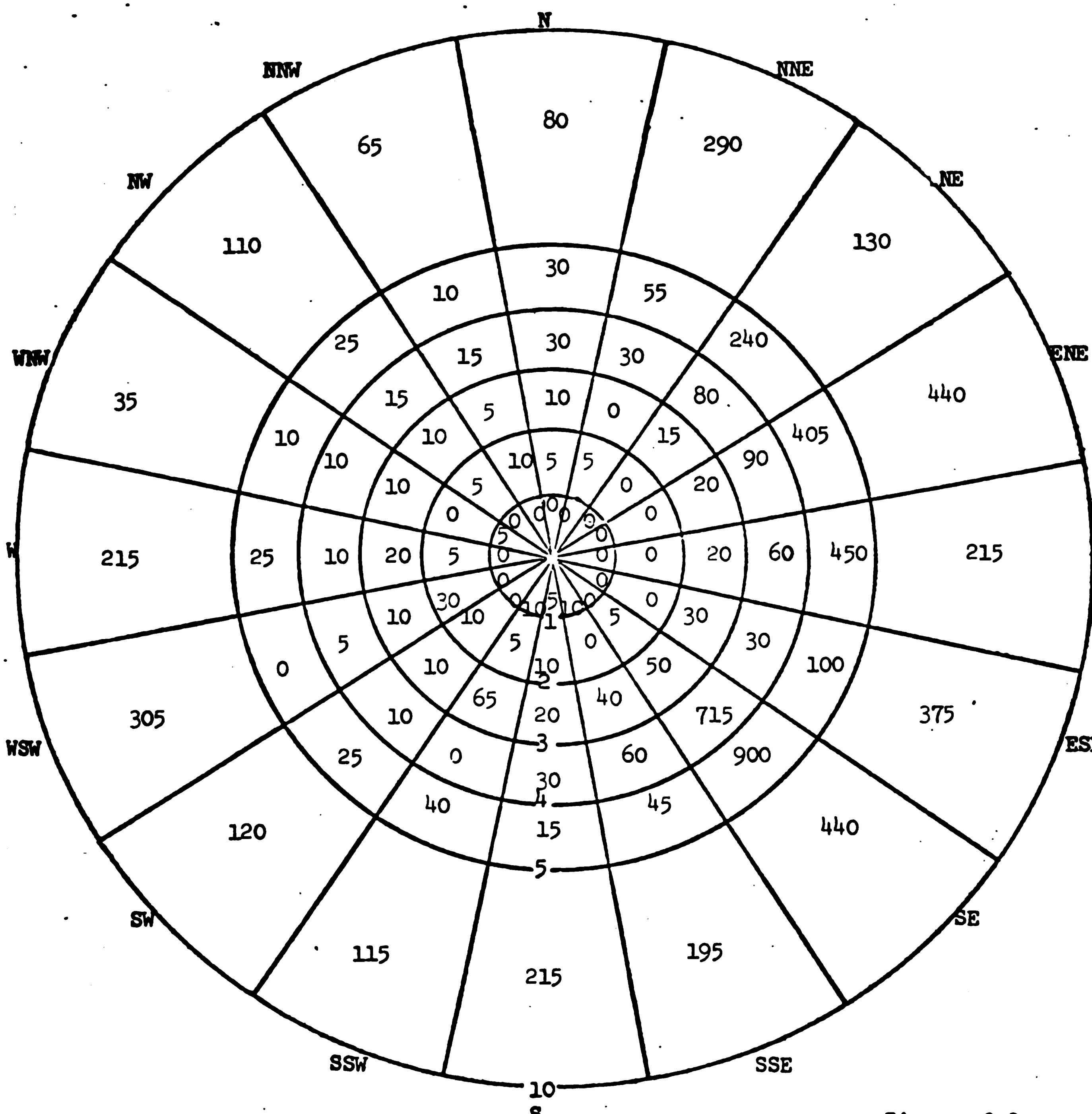

Figure 9-9

POPULATION DISTRIBUTION
COUNCIL BEND SITE
Year 1970

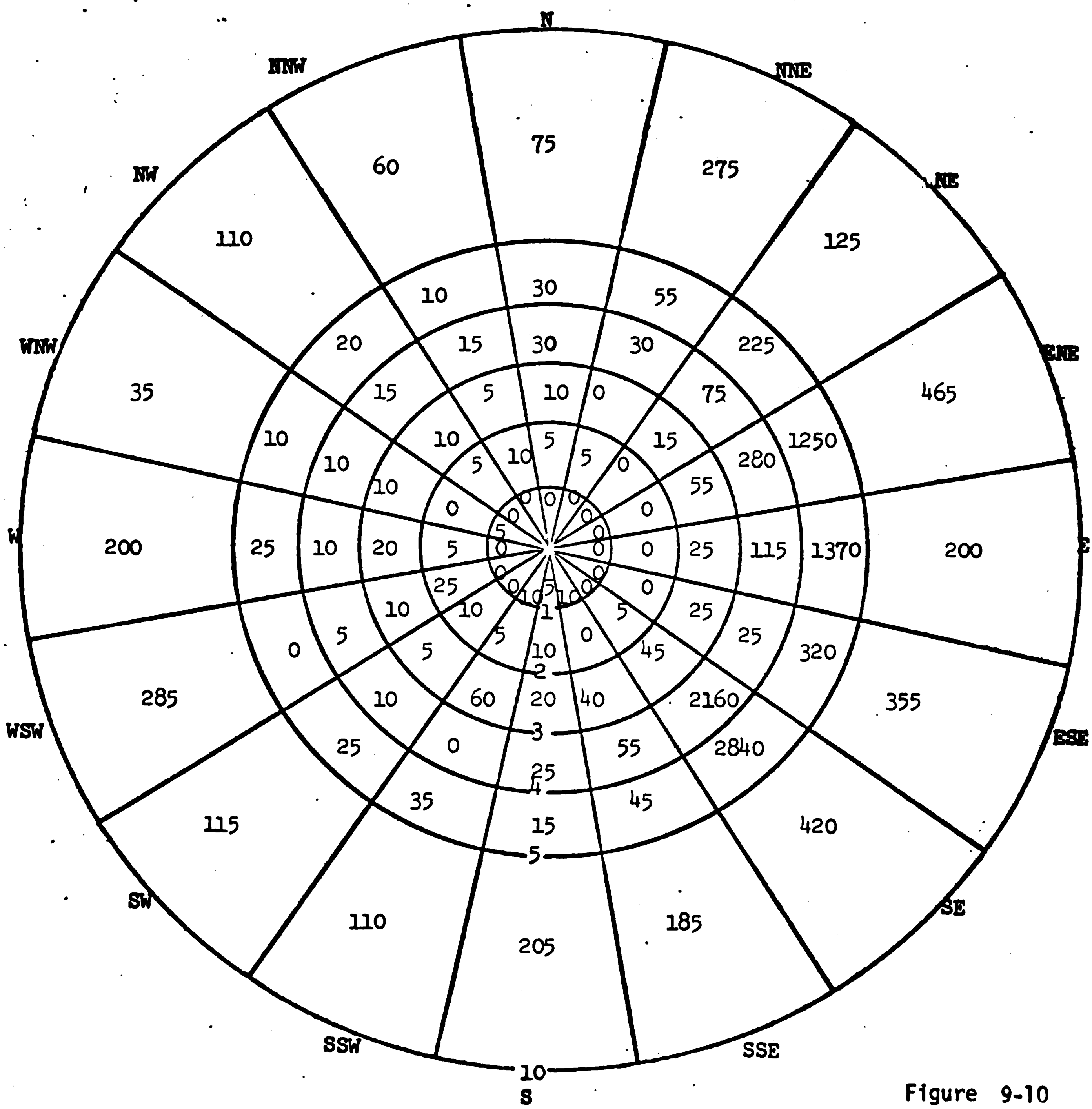

Figure 9-10

POPULATION DISTRIBUTION
COUNCIL BEND SITE
Year 2000

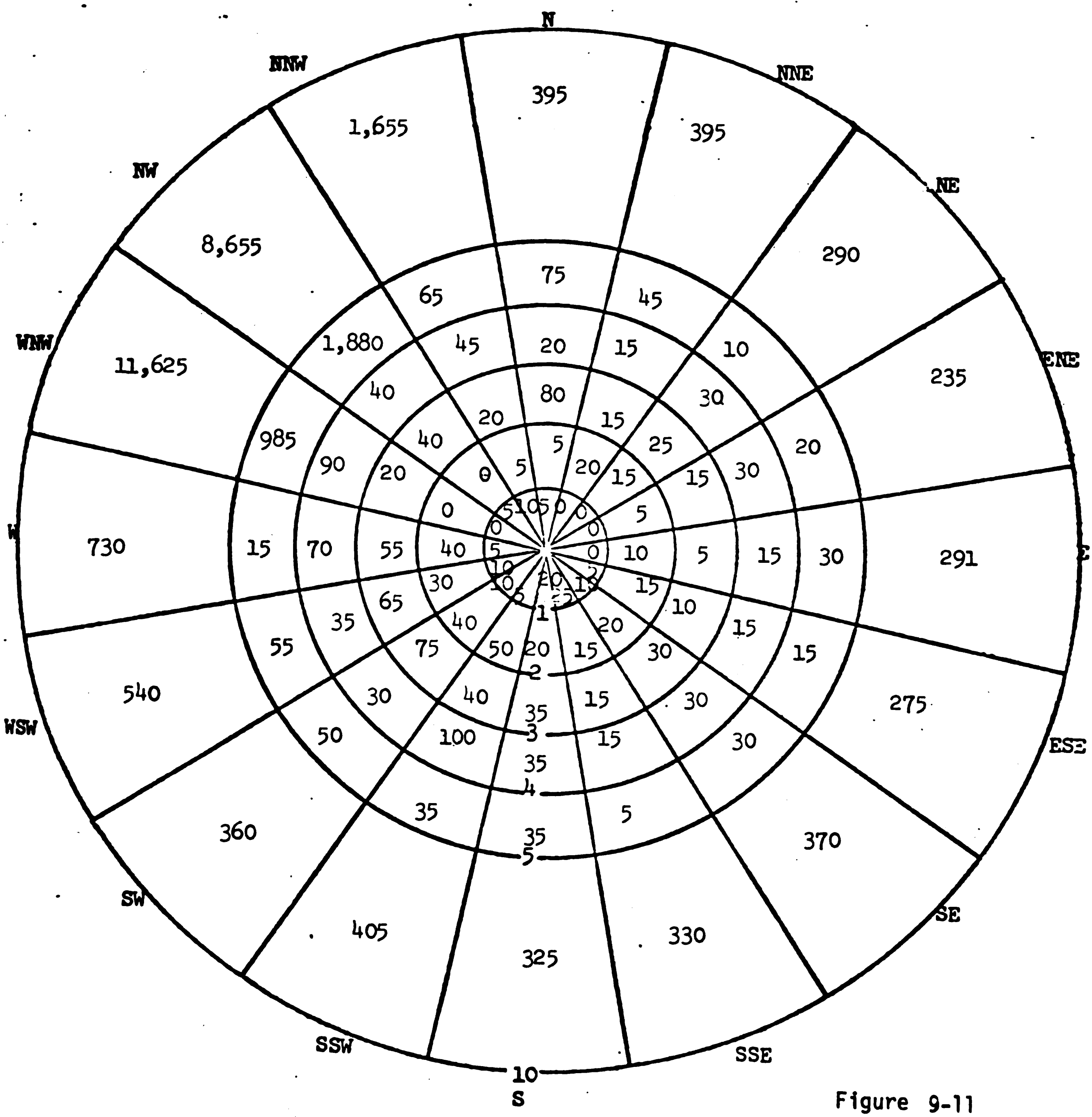

Figure 9-11

POPULATION DISTRIBUTION
RIEVES BEND SITE
Year 1970

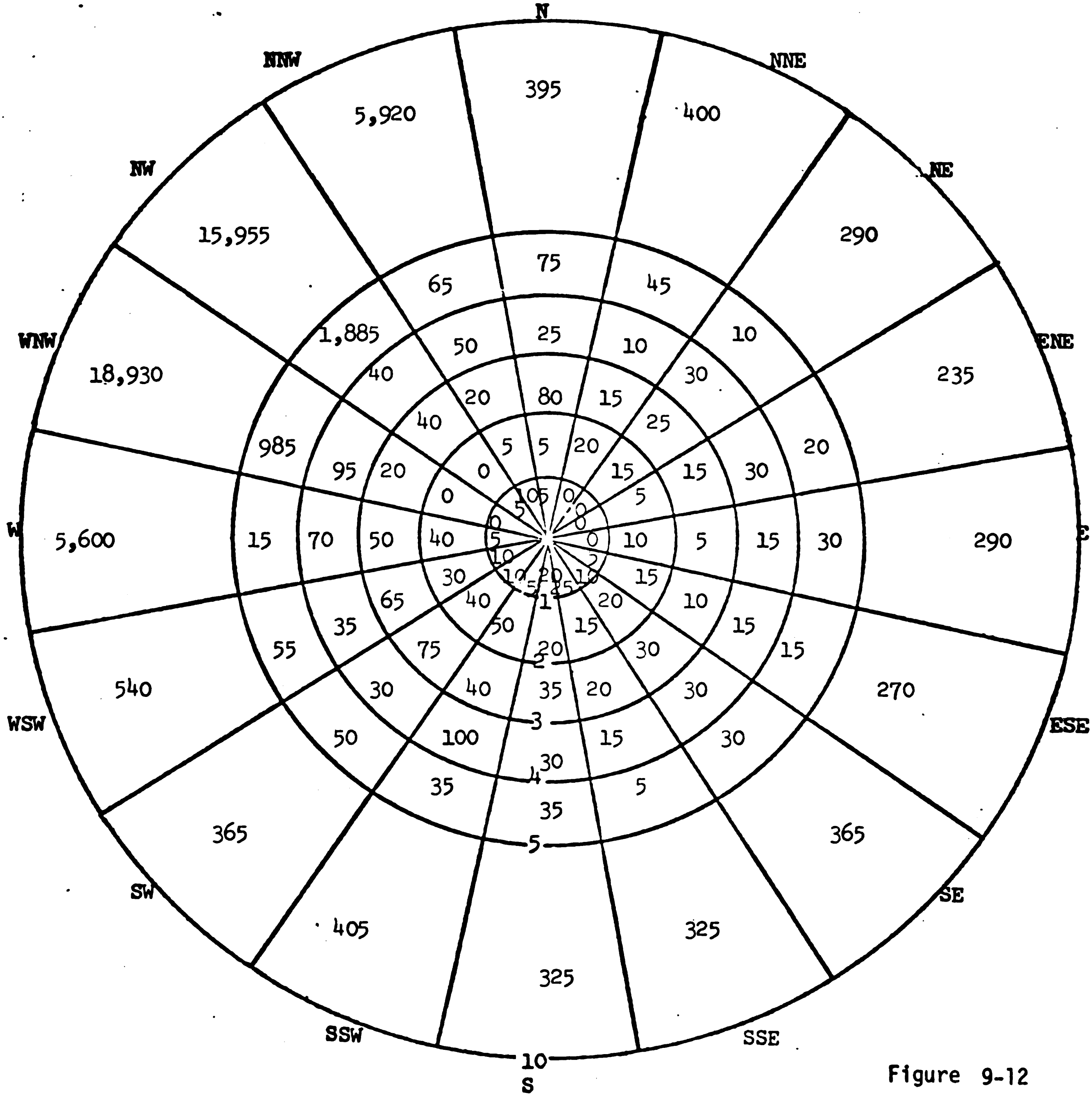

Figure 9-12

POPULATION DISTRIBUTION
RIEVES BEND SITE
Year 2000

COMPARISON OF POPULATION INCLUDED IN VARIOUS RADII

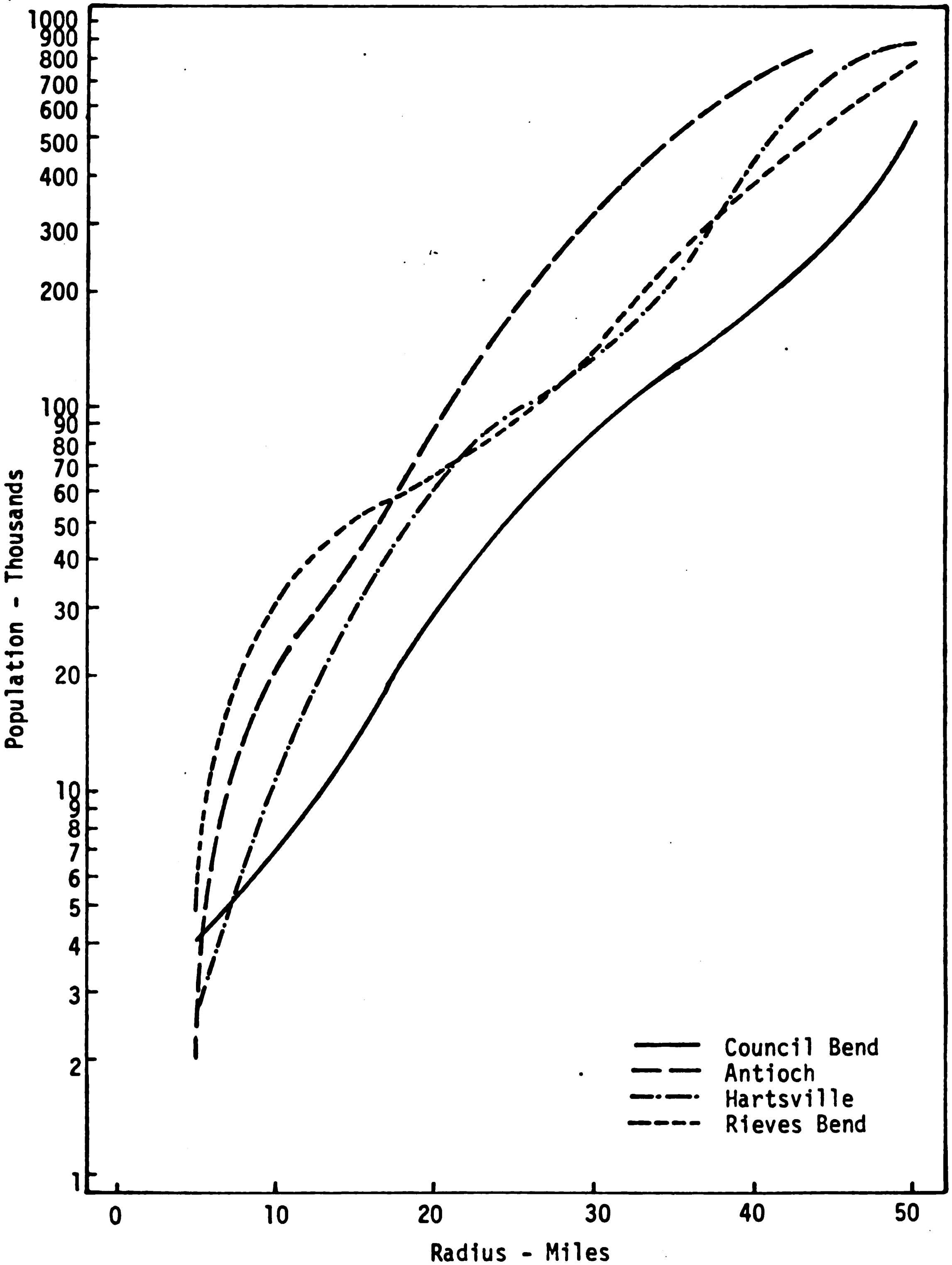

Figure 9-13

POPULATION DISTRIBUTION
VARIOUS RADII

10.0 Evaluation of Alternatives for Plant Systems

TVA is committed to improvement of the environment for the welfare of the people of the region and of the nation. In order to minimize as much as practical the impacts to the environment of the Hartsville plant, care was taken to select proposed systems for the plant which give the maximum protection to the environment which could reasonably be provided. To ensure this, systems which had potential environmental hazards were analyzed considering feasibility, economic costs, and environmental impacts. Maximum use was made of the various organizations within TVA in order to assure an integrated interdisciplinary approach to the analyses which would assure as complete and comprehensive a calculation as was possible. TVA feels this approach has resulted in the proposal of the optimum systems which when combined will result in the best possible total plant design. Alternatives for the following systems were considered.

1. Heat dissipation
2. Cooling tower blowdown treatment
3. Water makeup plant demineralizer spent regenerant treatment
4. Filter plant sludge treatment
5. Biocide treatment
6. Sanitary waste
7. Liquid radioactive waste treatment
8. Gaseous radioactive waste treatment
9. Plant water intake system
10. Plant liquid discharge system
11. Transmission line routes
12. Access railroad

Detailed assessments of the environmental impacts may be found in Chapter 10 of the Hartsville environmental report.

10.1 Heat Dissipation System

The State of Tennessee thermal water quality standards and proposed EPA effluent limitations effectively preclude the use of any heat dissipation system except closed cycle cooling at the Hartsville site. Therefore, only natural draft wet cooling towers, mechanical draft wet cooling towers, a cooling lake with a spray canal, a spray canal, and mechanical draft wet/dry cooling towers have been considered. Dry natural draft cooling towers are not considered feasible because of potentially serious operating problems, a lack of operating experience on large nuclear plants, and high economic costs. Combined cycle systems are not desirable because of the necessity at the Hartsville site of pumping the cooling water large distances resulting in higher operating costs, in addition to the increased costs of the larger intake and discharge structures. The economic and environmental advantages and disadvantages of the viable alternatives are carefully weighed.

The makeup water requirements for the alternatives considered are similar (within $\pm$ 16 percent of the requirements for the natural draft towers),

and the blowdown requirements for all alternatives differ only slightly. Therefore, the environmental effects of all the alternatives on the waters in the Cumberland River are judged to be essentially the same. During construction of the cooling lake and spray canals the adverse environmental effects of these schemes on the river would be somewhat greater than the other alternatives due to the greater land requirements and the corresponding greater erosion potential.

Since the general flow of groundwater in the site vicinity is toward the river and the effect on groundwater table of any of the alternatives would be very slight, if any, the environmental effect of the alternatives on the area groundwater is a insignificant factor.

A very important environmental effect of the heat dissipation alternatives is fogging and icing due to evaporation and drift from the cooling devices. All of the alternatives studied except the natural draft towers could potentially cause fogging over land areas, causing inconveniences and aggravation to local residents and resulting in a significant hazard to traffic on nearby roads. This is considered a potentially significant environmental impact which, although not quantifiable in terms of dollars, is quantifiable in terms of potential hours of fog per year and the potential number of vehicles per year that could be affected by the fog. These are tabulated for each alternative in Table 10.1-7 of the Hartsville environmental report.

Of the heat dissipation alternatives considered, the cooling lake would have a significantly greater environmental effect on people. Construction of the cooling lake would require an additional 5,000 acres of land; would affect approximately 500 more people than the other designs due to the necessity of inundating the communities of Dixon Springs and Johntown with the lake; and would inundate Dixona, a house near Dixon Springs included in the National Register of Historic Places, and other structures in Dixon Springs of possible historical significance. These structures would not be directly affected by selection of the other alternatives. All the alternatives would have some effect on land presently containing archaeological sites. The possible impact of the cooling lake alternative would be necessarily greater due to the additional large acreage required. However, potentially significant archaeological sites will be investigated and excavated if appropriate, regardless of the alternative selected. While the cooling lake would be an aesthetically pleasing body of water, the adverse effects of inundation of thousands of acres and dislocation of families are felt to far outweigh this beneficial effect. During plant operations none of the alternatives considered would have a significant impact on people due to noise emitted.

The natural draft cooling tower design is therefore proposed because it appears to have the best overall balance of economic costs and environmental impacts of all the alternatives. The spray canal, cooling pond with spray canal, and mechanical draft wet/dry cooling tower alternatives should not be selected because of higher economic costs with no significant improvement in overall environmental effects. The natural draft towers are proposed over mechanical draft towers due to the significantly smaller potential environmental impact from fogging and icing.

10.2 Cooling Tower Blowdown Treatment System

Partial treatment of blowdown and treatment with total recycle of cooling water were investigated along with the alternative of discharge of blowdown without treatment via the plant discharge diffuser. The two methods of treatment with total recycle of cooling water are very costly (approximately $44 million present value for the least expensive alternative) and of questionable reliability, since systems having the capacity which would be required for use at this plant have not been installed or operated previously. Either of these total recycle alternatives, if found feasible for this large scale operation, would have the advantage of no discharge of liquid to the river and would supply pure makeup water for the plant, eliminating the need for a separate water treatment plant. The environmental drawbacks of these systems are the requirement of extra energy consumption for operation, a significant solid waste disposal problem, and potentially large usage of chemicals to prevent equipment scaling, etc.

Partial treatment of blowdown would reduce the solids discharged back to the river by approximately one-half, reduce the blowdown requirements by about two-thirds, reduce the size of the mixing zone in the river, and require no sludge dewatering. However, the system would cost approximately an additional $8 million and present certain environmental disadvantages, including a liquid discharge with a pH 1.5 units higher than that of the makeup water; increased consumption of energy to operate the system; and some decrease in plant reliability, since the equipment involved could be subject to malfunction while having only a limited improvement in resulting solids concentrations in the reservoir (less than one percent difference). Moreover, after completion of the Environmental Protection Agency's effluent guidelines rulemaking, a system selected now may have to be substantially altered or replaced, adding unnecessarily to the cost of the project.

In summary, considering the commitment of funds necessary to treat blowdown and the questionable reliability of techniques available, it is felt that TVA should not commit to treat blowdown. Since cooling tower blowdown consists of essentially only those elements found naturally in the river, cleanup of these elements would not be warranted at the enormous expense required.

If, after the guidelines have been finalized, treatment is indicated then the design proposed does not preclude the addition of facilities that might eventually be required.

10.3 Makeup Water Demineralizer Spent Regenerant Treatment System

TVA proposes to neutralize discharges from demineralizer spent regenerant systems and discharge the neutralized wastes directly via the condenser cooling water blowdown.

This treatment is a commonly practiced method for industiral facilities and is considered to be environmentally acceptable for most applications.

This waste added to the condenser cooling water system blowdown discharge will not appreciably add to blowdown solids concentrations from that system.

An alternative system which utilized evaporation of the regenerant and burial of the residue was considered. While this alternative would have certain environmental advantages, such as elimination of any additional discharge to the river, it would also have the environmental disadvantage of requiring the disposal of approximately 200,000 pounds of solids each year.

From the review of the alternative for regenerant treatment, it is felt that treatment other than neutralization and discharge via the cooling tower blowdown is not justified.

Also upcoming EPA effluent guidelines may impose more stringent requirements on all discharges from the plant, which could render completely unnecessary the prior treatment of demineralizer spent regenerant. For instance, should treatment of cooling tower blowdown be eventually required, treatment of the blowdown stream could probably be accomplished at about the same cost whether or not it contained the spent regenerants. If the treatment of regenerants should be proposed in the future, the design as now proposed would not preclude the addition of these facilities.

10.4 Water Treatment Plant Sludges

Lagooning of water treatment plant sludges and filtering the sludges through sand beds were considered as alternatives to the proposed microsolids separation.

The method of treating water treatment plant sludges by microsolids separation is considered superior to the other methods considered both from an economic and environmental standpoint. Sand bed filtration and lagooning methods require a larger commitment of land; are open pit designs, considered less favorable aesthetically; produce a much larger volume of sludge; and are more expensive than the microsolids separation alternative. All other environmental effects of the alternative systems are essentially identical.

10.5 Condenser Circulating Water Biocide Treatment

Four alternatives were considered for chemical biocide treatment: Injection of chlorine as sodium hypochlorite, injection of gaseous chlorine, injection of acrolein, and generation and injection of ozone. Experience has demonstrated that mechanical tube cleaning alone is not a satisfactory method and additional chemical biocide treatment is required. All the alternatives were evaluated environmentally and none were found to have any potential significant environmental advantage. Ozone was not proposed because of the high economic cost and lack of operating experience using ozone as a condenser cooling system biocide. Acrolein was not proposed because of high economic cost, lack of effectiveness as a condenser cooling system biocide, and personnel safety hazards associated with its use. Sodium hypochlorite is proposed over gaseous chlorine because it is not as expensive, is more reliable, and is safer to handle.

10.6 Sanitary Waste Treatment Systems

Subsurface drainfields and sand filter systems were considered as alternatives to the proposed extended aeration package treatment plant. All three systems considered are felt to have similar environmental effects; however, the subsurface drain field, which is the lowest cost alternative, is felt to have some drawbacks. Due to the size of the required fields, significant problems may be expected which would reduce the reliability of the system and increase maintenance costs. These problems include both pluggage and overloading portions of the field.

Based on the small cost advantage of the drain field over other treatment systems and the other factors identified, TVA feels the drain field should be ruled out in favor of one of the more reliable alternatives. The sand filter treatment system was not economically favorable.

TVA believes that the extended aeration package plant is the optimum design considering economic costs, reliability, and environmental impacts for this application.

10.7 Liquid Radwaste Systems

The proposed liquid radwaste system is designed to provide treatment which reduces doses to levels which are as low as practicable in accordance with criteria defined by the AEC. The system was selected to provide the optimum of reliability and cost while meeting this criterion. Consequently, in accordance with AEC guidelines, no further consideration of alternatives is required.

10.8 Gaseous Radwaste Systems

The proposed gaseous radwaste system is designed to provide treatment which reduces doses to levels which are as low as practical. The system was selected to provide the optimum of reliability and cost while meeting this criterion. Consequently in accordance with AEC guidelines, no further consideration of alternatives is required.

10.9 Water Intake System

In reviewing the proposed alternative designs, it is found that for this site there is a considerable distance from the reservoir to the plant over which the makeup water would have to be transported. There are two methods of traversing this distance which are most feasible from an engineering viewpoint. One method would be to use an open channel constructed with riprap, etc., and allowing the water to flow by gravity to the pumping station. The other method, using buried pipe and locating the pump station nearer the reservoir to pump the water to the plant, has a considerable cost disadvantage. By balancing the costs of excavation against the costs of pipe, conduit, etc., and pumping cost, it is found that the optimum design from an economic viewpoint is to locate the pumping station about 2,500 feet from the reservoir, use the open channel from that point to the reservoir, and pump the water from the station to the plant.

The major differences in impact for these two designs are in the impacts on terrestrial land use. The open channel will remove about six acres of land from use as wildlife habitat, etc. This is not felt to be significant, as the land to be affected is presently agricultural land and is not regarded as highly productive wildlife habitat. Therefore, the use of the buried pipes would not be justified considering the high cost of the alternative.

An additional alternative consideration is the method of withdrawing the water from the reservoir. The lowest cost design is to have an open channel at the shoreline of the reservoir, drawing the water straight in through the channel. However, shallow shoreline areas are the most productive areas in the reservoir. For this reason, a reduction in environmental impact can be achieved by taking in the makeup water from deep water. In order to obtain makeup water from deep water, TVA proposes to place a dike at the shoreline of the intake channel and lay pipes beneath the dike so as to provide a flow path from midriver to the intake channel. Details of this proposed design are given in Section 3.4.2.

The preliminary analyses of the deep-water intake and the shoreline intake indicate that the additional cost of employing the deep-water intake design is justified, based on the considerable benefits which could be realized to the fish resources of the reservoir. Additional benefits which would be realized include reductions in the amount of trash taken in and disposed of, less frequent operational requirements for washing traveling screens and reductions in the entrainment of other biota from the reservoir.

10.10 Plant Discharge

A discharge system design utilizing a pond and a multiport diffuser is proposed.

A system utilizing a discharge pond was selected because it offers several environmental and operational advantages. The pond would allow discharge from the plant to be held up in the pond to meet water quality standards during periods of low river flow without jeopardizing the operation of plant which could result from having to shutoff blowdown from the cooling towers during these low flow periods. In addition, the pond could be used to contain a spill into the discharge system.

The use of the pond is felt to have no significant adverse environmental effects except for a slightly greater area of land impacted during construction. Because of all the above advantages a holding pond is included in the design.

Two types of diffusers were considered. A multiport diffuser is environmentally advantageous to a slot jet diffuser because of more desirable plume effects. In addition, the multiport diffuser has economic advantages and therefore this design is proposed.

Alternate diffuser locations were also evaluated. From a strictly economic standpoint, a diffuser location just off Dixon Island is best. However,

preliminary ecological investigations indicate that Dixon Island should be avoided. A diffuser system placed across or in the close proximity of Dixon Island could have an impact on the ecological balance of the island. Consequently, in order to avoid the island, a diffuser location several hundred yards downstream of Dixon Island was chosen (See Figure 3-2 for proposed diffuser location).

10.11 Transmission Facilities

In the initial route selection process, numerous possible alternate locations were investigated before the preferred corridors were selected. Figure 3-9 has been marked (dotted line) to identify alternate route corridors which were investigated for the line connections to the Hartsville Nuclear Plant.

10.11.1 Corridor 1a - The existence of rail connections north of Hartsville greatly enhances its potential for combined industrial and commercial development in this area of town. Corridor 1a would be approximately 11 percent longer than the preferred route and would require clearing of about 30 percent more acres of woodland. Corridor 1 was therefore selected as the preferred route.

10.11.2 Corridor 2a - A number of U.S. and state highways are crossed by this alternate corridor location with U.S. Highway 70S and U.S. Highway 41 being the more highly developed, both residentially and commercially.

The length of Corridors 2 and 2a are approximately the same, however, the land in the valley east of Murfreesboro has greater developmental potential than the more rugged land traversed by Corridor 2. The rapid intensification of land use presently exhibited adjacent to U.S. Highways 70S and 41, in the vicinity of Murfreesboro, indicates that conflicts with future developments would be highly probable. Corridor 2 was therefore selected as the corridor having the least environmental impact.

10.11.3 Corridor 3a - Corridor 3a traverses several areas that are presently under active development or which have good residential and water-based recreation potential. Notably, these are the areas west of Lebanon along U.S. Highway 70 and the land adjacent to the J. Percy Priest Reservoir. Due to the closer proximity to the Nashville metropolitan area, this corridor would also traverse more congested areas. For these reasons, Corridor 3a was rejected in favor of Corridor 3.

10.12 Access Railroad

Three possible routes were studied as access routes to the Hartsville site. These routes are shown on figure 10-1 and are designated as alternates A, B, and C.

Alternatives B and C have different types of adverse land use and socioeconomic impacts but, on balance, they seem to be roughly equivalent.

Alternative C has the better positive impact in that it would provide rail access directly to more potential waterfront industrial land. However, alternative B is significantly shorter and a spur could still serve the additional waterfront site.

The terrain on alternatives A and C is much rougher than alternative B, requiring larger cut and fill sections. In areas where cuts would be required on alternatives A and C, field inspections revealed rock outcrops. Construction of alternatives A and C would require more land for construction, would be longer, require the construction of more bridges and grade separations, and cross more existing roads. Alternative B is therefore proposed over alternatives A and C.

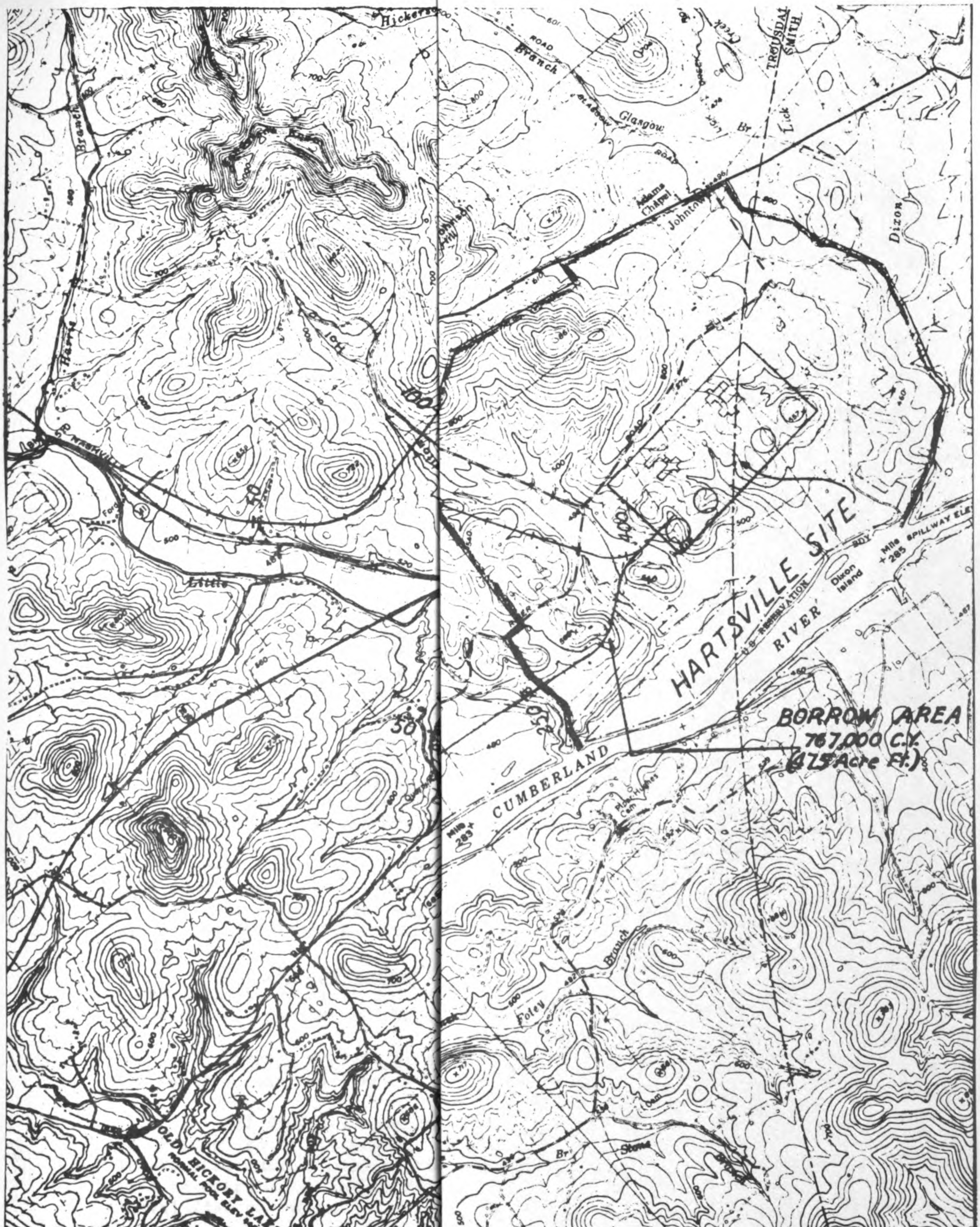

Figure 10-1

ACCESS RAILROAD
ALTERNATIVE ROUTES

11.1 Weighing and Balancing Project Benefits and Costs

This section summarizes the benefits and costs associated with the proposed Hartsville Nuclear Plant.

11.1.1 Benefits - The benefits that will be derived from this plant are discussed qualitatively in Section 8.0 and quantitatively in Section 8.1.

Included in these benefits are an ample supply of electricity to meet the region's needs and allow continued improvement of the quality of life in the region, the value of the electricity in revenues, increased payments in lieu of taxes to state and local governments, increase in regional gross product, recreational benefits, an improvement in air quality resulting from using less fossil-fuel, increased employment and employment potential, and education benefits derived from visits to the plant. These quantifiable benefits are tabulated in Tables 8-1 and 8-2.

11.1.2 Costs - The costs associated with the construction and operation of the plant will fall into three categories: economic, social, and environmental.

11.1.2.1 Economic Costs - The economic costs for constructing and operating the plant over a 35-year life include capital costs of land acquisition and improvement, capital costs of facility construction, capital costs of transmission and distribution facilities, fuel costs, operating and maintenance costs, plant decommissioning, license fees, and payments in lieu of taxes. These costs are discussed in Section 8.2 and are tabulated in Table 8-3.

11.1.2.2 Social Costs - Social costs associated with the construction and operation of a nuclear plant are complex and subject to modification by many factors. These costs are not easily quantified; and when quantifiable, it can seldom be done in monetary terms. Those social costs identified to date are discussed in Sections 4.2 and 8.2. Additional costs may be identified as studies progress. Also, programs for mitigating the social costs will be developed after additional study and consultation with local officials.

11.1.2.3 Environmental Costs - The environmental costs associated with the proposed plant are discussed in detail in Section 4.1 and Chapter 5. A summary of these costs is given below.

Natural Surface Water Body - Impingement of some fish due to the water intake will occur.

All aquatic organisms that pass through the intake screens are assumed to be destroyed. Because of the deep-water location of the intake structure, a minimal amount of phytoplankton and zooplankton will be entrained. Larval fish entrainment is estimated to be 16×10^6 larval fish per year.

The discharge is expected to release approximately 1.2×10^9 Btu/hr of heat to the reservoir. A mixing zone approximately 200 feet

wide, 15 feet deep, and 150 feet long will be created by the discharge. The area and volume of water with temperature rises greater than 5° F., 3° F., and 2° F. is tabulated in Table 11-1. Dissolved oxygen in the discharge water is expected to be greater than 5 mg/1 due to aeration by the cooling towers. Fish are expected to avoid the turbulence at the mixing zone, and there will be insignificant effects to fish outside the mixing zone because of the small change in temperature outside the mixing zone. Since the discharge diffuser and mixing zone do not span the entire river, there will be no barrier to fish migration.

Chemical effluents discharged from the plant will not appreciably impair the water quality of the Cumberland River. No additional dilution of the discharge is required after initial jet mixing in the reservoir to meet water quality standards. Therefore, no adverse effect is expected on aquatic organisms, wildlife, or people.

Doses to aquatic organisms as a result of radionuclides discharged from the plant are tabulated in Table 5-4. Internal and external doses to people as a result of radionuclides discharged from the plant are tabulated in Table 5-11.

Consumptive use of water at the plant will not diminish the supply of water needed by people, agriculture, or industry.

Erosion during plant construction will average about 1,500 tons per year. A portion of the silt is expected to settle in the yard drainage pond or holding ponds and no significant impact is expected in Old Hickory Reservoir. Chemicals used for cleaning during construction will be routed to holding ponds and neutralized before being released to the reservoir. No significant impairment of water quality is expected due to chemical cleaning during construction.

Net effects on Old Hickory Reservoir are expected to be inconsequential.

Ground Water - Ground water may be temporarily raised or lowered in the immediate vicinity of construction. However, this effect should not extend offsite nor last after construction is completed. No other significant effects on ground water are expected.

Air - Fogging and icing caused by the evaporation and drift from the natural draft cooling towers are not expected to affect ground, water, or air transportation. River fog due to plant discharge is estimated to affect river traffic about 497 hours per year. Vegetation is not expected to be significantly affected by fogging and icing.

Resulting average annual ambient pollutant levels due to gaseous emissions from the plant's auxiliary boilers and diesel generators have been estimated assuming combustion of 1.59×10^7 gallons per year of fuel oil with 0.5 percent sulfur content. Resulting annual average ambient levels as percents of the ambinet air quality standards, and tons per year of emissions assuming a consumption rate of 1,815 gallons per hour are given in Section 3.6. No odor originating from normal operation of the plant should be perceptible at any point offsite.

Doses due to radionuclides discharged to ambient air and direct radiation from radioactive materials are tabulated in Table 5-12 for people and table 5-5 for plants and animals.

There have been no significant impacts on air identified other than those discussed above.

Land - Approximately 1,940 acres of land will be contained within the site boundary. Approximately 1,750 acres of this land is presently in agricultural use and will be taken out of agricultural production.

Construction activities at the site will be controlled such that there will be no significant disturbances offsite due to noise and dust.

Accessibility of any historical site will not be affected by construction activity except possibly by traffic congestion due to increased traffic during construction.

Archaeological sites in the construction area that are potentially significant will be investigated prior to construction. If there are any sites of significance in the exclusion area that have not been investigated prior to plant operation, access to them will be restricted.

Land erosion during construction will average approximately 1,500 tons per year as approximately 700 to 800 acres of land are disturbed for facilities construction.

There should be no significant increase in noise levels offsite due to plant operation.

The visual effects of the plant are depicted in composite photographs contained in Section 3.1 of the environmental report. Although the plant and cooling towers are massive structures, location, design, and screening will reduce the visual impact offsite.

The habitat diversity and abundance of wildlife will increase since the site will be restricted and, except for the immediate vicinity of the structures, most of the land will be allowed to revert to a natural state.

Salts discharged by drift from the cooling towers are expected to fall primarily within 2,000 feet of the cooling towers. This area is completely within the site boundary. Since ground water in the site area moves toward the reservoir, no effects on ground water supplies of people in the area will occur. Plants and animals within the area of drift deposition may be affected by changes in moisture or chemical regimes; however, the changes would probably be subtle and extremely difficult to detect. Property resources offsite will not be affected by deposition of salts.

New transmission line rights of way needed for the Hartsville Nuclear Plant will amount to 194 miles and a total of 5,400 acres. Land use and aesthetics are discussed in Section 4.3.

Transmission facilities construction will require an estimated 116 miles of access roads.

Net effects on land will involve the use of approximately 7,415 acres of land in which present use may be changed and for which future use will be restricted.

11.1.3 Conclusion - This document reflects the manner in which TVA has incorporated environmental considerations into the decision-making and design processes.

The plant will interact with the environment in four principal ways: (1) release of minute quantities of radioactivity to the air and water, (2) release of minor quantities of heat to Old Hickory Reservoir and major quantities to the atmosphere, (3) release of minute quantities of chemicals to Old Hiclory Reservoir, and (4) change in land use from farming to industrial.

Alternatives to minimize adverse environmental impacts have been considered for all systems having a potential for significant impacts, and alternatives were chosen to reduce impacts to a minimum practical level. In addition, construction methods will be employed which minimize adverse impacts.

The plant as now designed closely approaches a minimum impact plant and can be constructed and operated without significant risk to the health and safety of the public.

The addition of the Hartsville Nuclear Plant to the TVA system will enable TVA to continue to fulfill its statutory obligation to provide an ample supply of electricity for the TVA region.

After weighing the environmental costs and the technical, economic, environmental, and other benefits of the project and adopting alternatives which affect the overall balance of costs and benefits by lessening environmental impacts, TVA has concluded that the overall benefits of the project far outweigh the monetary and environmental costs, and that the action called for is the construction and operation of the Hartsville Nuclear Plant.

Table 11-1

Cost Description of Proposed Facility and Transmission Hook-Up

(All Monetized Costs Expressed in Terms of Their Present and Annualized Values)

Generating Cost	Present Worth - $3,081,629,000 Annualized - $ 264,404,000
Transmission and Hook-up Cost	Present Worth - $ 104,586,000 Annualized - 8,973,000

Environmental Costs	Units	Magnitude
1. NATURAL SURFACE WATER BODY		
1.1 Impingement or entrapment by cooling water intake structure		See text
1.1.1 Fish		
1.2 Passage through or retention in cooling systems		
1.2.1 Phytoplankton and zooplankton		See text
1.2.2 Fish	Larval fish per year	16×10^6
1.3 Discharge area and thermal plume		
1.3.1 Water quality, excess heat	Btu/hr discharged	1.24×10^9
	Acres of water surface with $\Delta T > 5^\circ$ F.	0
	Acre-feet of water with $\Delta T > 5^\circ$ F.	14
	Acres of water surface with $\Delta T > 3^\circ$ F.	1,000
	Acre-feet of water with $\Delta T > 3^\circ$ F.	20,000

Table 11-1
(Continued)

Environmental Costs	Units	Magnitude
	Acres of water surface with T > 2° F.	1,660
	Acre-feet of water with T > 2° F.	37,000
1.3.2 Water quality, oxygen availability	Volume of water with concentration less than 5 mg/l	0
1.3.3 Fish, nonmigratory		See text
1.3.4 Fish, migratory		See text
1.3.5 Wildlife (including birds, aquatic and amphibious mammals, and reptiles)		See text
1.4 Chemical effluents		See text
1.5 Radionuclides discharged to water body		
1.5.1 Aquatic organisms		See table 5-4
1.5.2 People, external		See table 5-12
1.5.3 People, ingestion		See table 5-12
1.6 Consumptive use		
1.6.1 People	Gallons per year	0
1.6.2 Agriculture	Acre-feet per year	0
1.6.3 Industry	Gallons per year	0
1.7 Plant construction (including site preparation)		
1.7.1 Water quality, physical		See text
1.7.2 Water quality, chemical		See text
1.7.3 Aquatic		See page 11-3
1.8 Other impacts		None expected
1.9 Combined or interactive effects		None identified
1.10 Net effect	Qualified opinion	See text

Table 11-1
(Continued)

Environmental Costs	Units	Magnitude
2. GROUND WATER		See text
3. AIR		
3.1 Fogging and icing (caused by evaporation and drift)		
3.1.1 Ground transportation	Hrs. per year	0
3.1.2 Air transportation	Hrs. per year	0
3.1.3 Water transportation	Hrs. per year	497
3.1.4 Plants	Qualified opinion	See text
3.2 Chemical discharge to ambient air		See text
3.3 Radionuclides discharged to ambient air and direct radiation from radioactive materials		
3.3.1 People, external		See table 5-12
3.3.2 People, ingestion		See table 5-12
3.3.3 Plants and animals		See table 5-5
3.4 Other impacts on air		None identified
4. LAND		
4.1 Site selection		
4.1.1 Land, amount	Acres	1940
4.1.2 Land, agricultural	Acres removed from production	1750
4.2 Construction activities (including site preparation)		
4.2.1 People (amenities)		See text
4.2.2 People (accessibility of historical sites)		See text
4.2.3 People (accessibility of archaeological sites)		See text
4.2.4 Wildlife		See text
4.2.5 Land (erosion, affected area)	Tons per year Acres	1,500 700 to 800

Table 11-1
(Continued)

Environmental Costs	Units	Magnitude
4.3 Plant operation		
4.3.1 People (amenities)		None
4.3.2 People (aesthetics)		See text
4.3.3 Wildlife		See text
4.3.4 Land, flood control		N/A
4.4 Salts discharged from cooling towers		
4.4.1 People	No. of people	None
4.4.2 Plants and animals		See Section 5.4
4.4.3 Property resources		No effect
4.5 Transmission route selection		
4.5.1 Land, amount	Miles	194
4.5.2 Land use and land value	Acres	5,400
4.5.3 People (aesthetics)		See Section 4.3.5
4.6 Transmission facilities construction		
4.6.1 Land adjacent to right of way	Miles	116
4.6.2 Land, erosion	Tons/Acre/Year (3-year average)	0.5
4.6.3 Wildlife		See Section 4.3.2
4.6.4 Flora		See Section 4.3.2
4.7 Transmission line operation		
4.7.1 Land use		See Section 5.5
4.7.2 Wildlife		See Section 5.5
4.8 Other land impacts		
4.8.1 Access railroad	Acres	75
4.9 Combined or interactive effects		None
4.10 Net effects		See text

12.0 Environmental Approvals and Consultations

In addition to its own standards, TVA as a Federal agency is subject to comprehensive and broad-scale environmental procedures and Federal and state consultation and coordination requirements of the National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321 et seq. (1970) as implemented by Executive Order 11514 (3 C.F.R. 526 [1972]). In addition, TVA is subject to Office of Management and Budget Circulars A-78 and A-81, relating to the prevention, control, and abatement of air and water pollution in Federal facilities, as well as certain provisions of the Clean Air Act, as amended, 42 U.S.C.A. § 1857 (1971), and the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), which relate to the applicability of various Federal, state, interstate, or local air and water quality standards. In addition, TVA is subject to the requirements of Office of Management and Budget Circular A-95 which ensure that major generating and transmission projects are coordinated from the point of view of community impact and land use planning with state and local agencies.

TVA has been consulting with state and regional organizations since October 1972 about the possibility of a nuclear plant at the Hartsville site and its implications on the development of the area.

On October 6, 1972, TVA met with officials of the State of Tennessee in Nashville to discuss sites in the middle Tennessee area which might be the location for a nuclear plant. The need was established for early input from the State on four sites. On November 1, 1972, information was received on the four alternative sites being reviewed by the State.

On February 23, 1973, public announcement was made concerning TVA's intention to construct a nuclear plant at the Hartsville site. On April 12, 1973, TVA met with State, regional, and local organizations and interested citizens to discuss the Hartsville site and the possible impacts if a nuclear plant were built there.

TVA is also subject to the provisions of the following requirements relating to the preservation of cultural, historical, archaeological, and architectural resources: The National Historic Preservation Act of 1966 (16 U.S.C. §§ 470-70n (1970)); Executive Order No. 11593 (3 C.F.R. 154 (1971)); and Public Law 93-291 (May 24, 1974).

On July 9, 1973, further comments were received from the State Historical Commission on the historical aspects of the Hartsville site and surrounding area. On August 9, 1973, TVA and State officials met in Hartsville to discuss and observe the potentially significant historical structures in the area.

In mid-October 1973, TVA participated in a meeting with a large number of State and regional planning and assistance organizations to discuss assistance to the Hartsville area to absorb construction impacts. Approximately three months later on January 23, 1974, the manpower needs were discussed with the Mid-Cumberland Development District Manpower Planning Board.

In addition to the recorded consultations outlined above, TVA has held public information meetings in Lebanon, Carthage, Gallatin, Lafayette, and Hartsville.

In developing the proposed transmission line routes which are described in Section 3.9.3, preplanning discussions were held with the following Federal and state commissions, departments, and planning agencies. Through the early disclosure of TVA's plans, potential conflicts with other agency programs or interests have been factored into the decisionmaking process. No major conflicts or environmental impacts were identified which may result from this project that cannot be reasonably controlled or avoided.

Upper Duck River Development Agency
Tennessee Department of Conservation
Federal Aviation Agency
Upper Cumberland Development District
U.S. Department of Agriculture, Soil Conservation Service
Tennessee Game and Fish Commission
Tennessee State Planning Office
South Central Tennessee Development District
Mid-Cumberland Council of Governments
Tennessee Department of Transportation

Within TVA, this project was developed in consultation with the following organizations.

Division of Water Control Planning
Division of Navigation Development and Regional Studies
Office of Tributary Area Development
Division of Reservoir Properties
Division of Forestry, Fisheries, and Wildlife Development
Division of Environmental Planning
Division of Agricultural Development

In addition to meeting the requirements of NEPA, TVA is also required to obtain a permit under Section 402, National Pollutant Discharge Elimination System, of the "Federal Water Pollution Control Act Amendment of 1972." At the present time, there is no application for a permit under this Act.

In addition, a construction permit and operating license are required under the Atomic Energy Act of 1954 and 10 C.F.R. Part 50 for the construction and operation of the four units of the Hartsville Nuclear Plant.